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ON

CLUB-FOOT

AND

ANALOGOUS DISTORTIONS.

ON THE

NATURE AND TREATMENT

OF

CLUB-FOOT

AND

ANALOGOUS DISTORTIONS INVOLVING THE TIBIO-TARSAL ARTICULATION.

THE
PROPERTY
YORK HOSPITAL

BY

BERNARD E. BRODHURST,

ASSISTANT-SURGEON TO THE ROYAL ORTHOPÆDIC HOSPITAL; SURGEON TO THE
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THE RIGHT HONOURABLE

ANTHONY ASHLEY-COOPER, D.C.L., F.R.A.S.,

EARL OF SHAFTESBURY,

PRESIDENT OF THE ROYAL ORTHOPÆDIC HOSPITAL,

ETC. ETC.,

This Treatise is inscribed,

IN TESTIMONY OF THE ASSIDUITY AND SUCCESS WITH WHICH
HIS LORDSHIP DEVOTES HIMSELF TO THE CAUSE OF
THE POOR AND THE AFFLICTED.

MY LORD,

I gladly avail myself of your kind permission to dedicate this Treatise to your Lordship. It embraces a portion only of an extensive subject, which has cursorily been brought under your Lordship's notice during your visits of inspection at the Orthopædic Hospital. Time will, I trust, enable me to render it more complete by adding other portions of the subject which yet remain to be treated of.

Your Lordship knows well how large a portion of the community is afflicted with distortions of one kind or another, and how greatly these can be alleviated, if not entirely removed. A more comprehensive knowledge of these affections than at present obtains, is required to render Orthopædy generally available to the wants of the population. Should this treatise in any measure contribute to a better understanding of the affections in question, my object will be gained.

I have the honour to be,
MY LORD,
Your most obedient, humble servant,
THE AUTHOR.

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PREFACE.

THE following chapters have already appeared in the pages of the 'Medical Times and Gazette.' Since their publication in that periodical, however, they have been re-written, and much new matter has been added. The author hopes that, in their present form, they may prove acceptable to those who consult works on this subject. He has endeavoured to weigh with care the various arguments which have, from time to time, been advanced in support of different theories; and in stating his own opinions on these and other disputed points, he has not been unmindful of the respect due to greater experience than his own; yet, he has ever borne in mind the precept of Cullen, that, "*Without principles deduced from analytical reasoning, experience is a useless and blind guide.*"

Many circumstances tend to vitiate statements dignified with the name of experience; but perhaps no circumstance contributes more essentially to error than insufficient education—want of knowledge to appreciate facts, and logically to draw conclusions. To reason accurately demands freedom from prejudice, and a knowledge of facts sufficient to suppress those hypotheses which invade uncultivated minds. And without the mind be constituted to appreciate truth, experience becomes a blind guide, which leads to error as surely as the ignis fatuus misleads the benighted traveller.

Insufficient inquiry and insufficient knowledge to investigate and recognise *facts*, are fertile sources of error.

And, as is too frequently observed, the application of deductions to circumstances not precisely similar, is an inevitable source of error. But ignorance is more excusable than the wilful perversion of facts. Nothing can be more disingenuous than the suppression of a part of the truth. This is want of veracity, to which some yield who are content to maintain error at the expense of truth, for their own justification and for the advantage of their own preconceived opinions.

These several causes have tended to retard the onward progress of orthopædy. Impudent charlatans are yet permitted to abuse the good faith of the public. Ignorance prevails to an untold extent, with regard to the entire subject of orthopædy. And even in quarters which should be beyond suspicion, empiricism exists, which seriously injures the cause of science and of humanity.

The author is indebted to his colleagues, Mr. Tamplin and Mr. Lonsdale, for permission to take drawings from their patients, or from plaster casts taken from their patients, for some of the lignographs in the following pages. To both of them he renders his best thanks. Those figures numbered 14, 15, 16, 19, 22, and 24 are from cases under the care of Mr. Tamplin; and those numbered 12, 13, and 23, under the care of Mr. Lonsdale; whilst those numbered 10, 26, and 27, were taken from casts in the Hospital Museum. The remainder are from casts or original drawings in the possession of the author. The engravings were executed by Mr. Bagg, with his usual care and ability.

14, Brook Street, Grosvenor Square;
March, 1856.

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ON

CLUB-FOOT

AND

ANALOGOUS DISTORTIONS,

INVOLVING THE

TIBIO-TARSAL ARTICULATION.

CHAPTER I.

INTRODUCTION.

Orthopædy, a term derived from ὀρθὸς, straight, and *παιδῖον*, a child, was introduced into the language of science by Andry. "From these two words I compose," he says, "the term *orthopædy*, to express in one word the design which I propose to myself, of inculcating the means of preventing and correcting in children deformities of the body."[1]

Orthopædic surgery, at the present time, comprises the treatment of congenital and non-congenital distortions of the trunk and extremities; such as curvature of the spine, distortions of the neck, the globe of the eye, the hands, feet, &c., whether produced by abnormalities of skin, muscle, fascia, bone, or ligament; and also those which result from chronic affections of joints, and terminate in partial displacement of the articular surfaces, or in muscular retraction.

---

[1] 'L'Orthopédie,' par M. Andry, Conseiller du Roy, Lecteur et Professeur en Médecine au Collége Royal, Docteur Regent, et ancien Doyen de la Faculté de Médecine de Paris, tome i, p. 2, 1741.

Mention is made of some of these affections by Hippocrates.

> "In all the works on ancient surgery, I verily believe," says his translator, "there is not a more wonderful chapter than the one which relates to *Club-foot*, § 62. In it he has not only stated correctly the true nature of this malformation, but he has also given very sensible directions for rectifying the deformity in early life. Now it appears to me a lamentable reflection, as proving that valuable knowledge after being discovered may be lost again to the world for many ages, that not only did subsequent authorities, down to a very recent period, not add anything to the stock of valuable information which he had given on the subject, but the important knowledge which he had revealed to the profession came to be disregarded and lost sight of, so that, until within these last few years, *talipes* was regarded as one of the 'opprobria medicinæ.'"[1]

In the 62d chapter of the Book "On the Articulations," he says:

> "Most cases of congenital club-foot are remediable, unless the declination be very great, or when the affection occurs at an advanced period of youth. The best plan, then, is to treat such cases at as early a period as possible, before the deficiency of the bones of the foot is very great, and before there is any great wasting of the flesh of the leg. There is more than one variety of club-foot, the most of them being not complete dislocations, but impairments connected with the habitual maintenance of the limb in a certain position."

---

[1] 'The Genuine Works of Hippocrates,' p. 560, vol. ii. Sydenham Society's Edition.

Directions are then given for the application of bandages to remove the deformity, wherein is expressed, as has been well said by M. Jules Guérin, all that is required to be done for the reduction of varus. After the bandage has been applied,

> "A small shoe made of lead is to be bound on externally to the bandaging, having the same shape as the Chian slippers had. . . . This, then, is the mode of cure, and it neither requires cutting, burning, nor any other complex means; for such cases yield sooner to treatment than one would believe. However, they are to be fairly mastered only by time, and not until the body has grown up in the natural shape."[1]

It is clear from this chapter that the nature of the affection, and the mechanical treatment necessary for the removal of the distortion, were understood by Hippocrates; and, as Dr. Little has remarked, a doubt may be entertained, in consequence of the allusion to cutting in the last sentence quoted, whether he ever practised or witnessed the section of tendons for club-foot.

For 2000 years and more, nothing of importance was added to the knowledge collected by Hippocrates on this subject, and handed down to us by Polybus. The subject of club-foot occurs, however, in the works of several authors; as for instance, in those of *Ambroise Paré*, Lyon, 1641; *M. A. Severinus*, Francof., 1643; *Arcæus*, Amst., 1658; *Fabricius* ab Aquapendente, Lugdun. Bat., 1723.

Arcæus describes the process by which distortion is to be removed, and figures an apparatus and a boot, by means of which he was accustomed to treat this deformity. (*Vide* figs. A and B.)

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[1] Op. cit., vol. ii, p. 634.

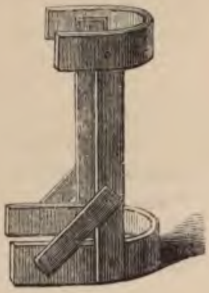

Fig. A.

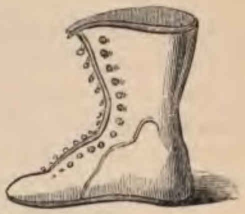

Fig. B.

Du Verney, in his work, 'Traité des Maladies des Os,' 1751, devotes a chapter to the subject, "Des Pieds bots." He recognises muscular retraction as the cause of club-foot, and describes the distortion as due to the influence of the muscles and ligaments. He writes of varus and valgus, "these distortions depend entirely on the unequal tension of the muscles and ligaments; for those muscles which are extremely tense draw the parts towards them, while their antagonists yield, being relaxed."

Blumenbach, Naumberg, and others, advanced and supported incorrect ideas of the disposition of the tarsal bones, and of the causes of club-foot.

In the eighteenth century, Venel, of the Canton of Berne; Wanzel, of Tubingen, who was himself cured of club-foot by Venel; Ehrmann, of Frankfort; Jackson, in England; Brückner, in Gotha; Tiphaisne and Verdier, in France, treated these affections empirically.

At the commencement of the present century, *Scarpa*, the illustrious professor, of Pavia, published his work[1] on club-foot, in which he maintains the opinion entertained by Hippocrates, that the tarsal bones are not dislocated, but twisted on their smaller axes: he contends that the primary disturbance is in the osseous system, and that consequent on this displacement, the muscles are elongated or retracted, according to their position. He describes and figures an instrument for the removal of varus, which is still in use for that distortion.

Palletta, 'de loxarthro,' states his belief, that the malleolus internus being wanting, or in part deficient, is the primary cause of varus.

> "In nonnullis interior malleolus aut deficere, aut certe brevior esse videbatur, ut propterea pes adducentium musculorum actionem sequeretur. In plerisque autem, in quibus malleolus certe non desiderabatur, caussa, ob quam pedes interius converterentur, videbatur in aucta musculorum adducentium actione consistere, qui pedem ad naturalem figuram restitutum, mox in interiorem partem contorquebant." [2]

Rudolphi[3] is perhaps the first who arrived at a more correct view of the causes of varus. He saw that club-hand and club-foot were analogous distortions, not dependant on extrinsic causes, and frequently occurring in young children from irritation and spasmodic action. He says:

> "I presume that club-hand and club-foot in the fœtus arise alone through morbid nervous influence acting on the muscular system. Those who believe in an extrinsic, mechanical cause, as pressure, through an unnatural position, cannot be aware that distortions of this kind have frequently been found in the embryo as early as the third or fourth month."

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[1] 'Memoria Chirurgica sui Piedi torti Congeniti dei Fanciulli,' Pavia, 1806.

[2] 'Exercitationes Pathologicæ,' cap. x, art. 5, 1820.

[3] 'Grundriss der Physiologie,' 1823.

Cruveilhier[1] added some valuable information on the pathological anatomy of club-foot. Entertaining, however, an erroneous opinion with regard to club-hand, namely, that distortion ceased immediately after birth, he concluded that the deformity was induced by the cramped position in utero; and reasoning from club-hand to club-foot, he asserted that position in utero was the sole cause of these congenital distortions. But his premises were false, and consequently his deductions. So far from club-hand ceasing as soon as the pressure of the uterus is removed, namely at birth, it may continue for months, and years even, without marked amendment. Had these cases been brought under Cruveilhier's observation, he would never have asserted, that "these distortions must arise from pressure in utero, because removal of pressure causes the removal of distortion."

But towards the end of the last century, viz., in 1784, a new era opened to orthopædy, when tenotomy was for the first time practised to remove distortion. Thilenius, of Frankfort, divided the tendo Achillis for the removal of talipes equino-varus. The case is recorded by him as follows:

> "A young person of this town (Frankfort), 17 years of age, who had been afflicted from her earliest childhood with lameness of the left foot, walked on the outer edge of the foot, and twisted the foot in walking. Every kind of bandage, boot, and ointment had proved of no avail. The patient limped frightfully, and the foot was bent so much forward, and the tendo Achillis was so shortened, that she walked almost entirely on the dorsum of the foot; and the surface on which she trod being always excoriated, she only limped slowly about the house.

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[1] Anatomie Pathologique du Corps Humain,' Paris, 1829—1835.

26th of March, 1784, the tendo Achillis was divided, and ne ounce of blood was lost. Immediately the heel two inches, and the foot could be placed flat on the ground. m, Mr. Lorenz, then bandaged the foot, and the healing oceeded so favorably, that on the 12th of May, the large d completely cicatrized, without a single unfavorable

ome time after this, emollient baths were used, and lthææ was rubbed over the tendon ; and now the girl can rly again, and like other people."[1]

us never again undertook a similar operation, and o years elapsed before it was repeated. At this ely, in 1806, Sartorius performed the section of Achillis, and the following is his account of the

l Restoration of a Contracted Foot through Division of do Achillis. By Johann Friedrich Sartorius.

0th of May, 1806, I saw the son of Martin Aust, of He was 13 years of age. The right leg was thinner than the sound one, and marked by long and deep cicatrices ; the tendo Achillis was remarkably tightly stretched, as was apparent throughout the entire calf of the leg ; the heel was drawn up ; the positions of all the bones of the foot were changed from their natural directions, so that the metatarsus was laid upon and formed an angle with the tarsus, and the whole foot described, as it were, a bow ; in a word, the foot was so bent that the patient brought the dorsum, instead of the sole of the foot, to the ground. The tendo Achillis was shortened, so that I was not able, with all the force I could use, to move the foot in its normal direction forwards. The effort which I made gave the patient great pain, and the muscles of the calf were so stretched, that the tendo Achillis became exceedingly tense.

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[1] 'Medicinische und Chirurgische Bemerkungen,' von M. G. Thilenius, Frankfurt, 1789. In a posthumous edition of his works, this case was omitted.

"Concerning the origin of the malady, I learnt that, until his seventh year, the patient enjoyed good health, passing through the different forms of disease incident to childhood, without any circumstance worthy of remark. During the winter of his seventh year, he fell into the water; and fearing that he might be punished, did not mention the circumstance, but continued to wear his wet clothing throughout the day. Four days after this occurrence, slight pain was felt in the calf of the right leg, which increased daily until redness and swelling, together with darting pain, fever, and thirst supervened.

"Every imaginable remedy was used, yet swelling and pain increased every day, until, about the twenty-second day, the abscess burst, and some pus escaped: similar openings subsequently formed in the neighbourhood of the calcaneum. A surgeon in the neighbourhood was now summoned, and in time cicatrization took place, but only after the abscess had been discharging for a space of six months, during which time the boy had been for the most part confined to bed. After the wounds had healed, it was found that the sole of the foot could not be put to the ground, but the toes only. At first this circumstance did not attract much attention, but it continued without alteration, and during four years the toes only were brought to the ground. Distortion increased gradually, and for a year and a half the dorsum of the foot was brought to the ground in walking; so that he was compelled to wear a laced boot with a sole on the front of the boot. His general health was good.

"I wished to try the effect of embrocations; but similar means having been employed unsuccessfully for some years, and the baths of Ems and Wiesbaden having been used without benefit, the parents were unwilling to lose more time in making repeated trials of a similar kind, but desired that the foot should be forcibly restored to its proper shape. I was not, however, at once able to make up my mind as to the propriety of such a violent proceeding, and requested time for reflection.

"On May 14th, I was at the parsonage close by, and sent for the father and son, and again inquired into all the circumstances above detailed. I was doubtful if I should attempt the cure by means of bandages and embrocations, or if I should divide the tendo Achillis, and then forcibly restore the foot to its normal position. I decided on the last mentioned plan, and, in the presence of the clergyman, told the father, at the same time declaring that I could not be answerable for the result of the operation—that the boy might lose his foot, or his life even; but that I hoped such an unfortunate occurrence would not take place; that the shape of the foot would be perfectly restored, and that he would be able to tread on the sole of the foot. The father consented to the operation, and added, that this was his only child, but that it would be better he should cease to live, than continue to be so deformed. He confided him to me, and desired me to do whatever was necessary for the removal of the deformity. The boy seemed well pleased with the determination. I took the necessary measures that bandages might be prepared.

"On May 16th, I took with me everything necessary, and performed the operation in the following manner:—I bandaged the thigh and leg, as far as the middle of the calf, with a long bandage, applied a long compress in the course of the femoral artery, and a tourniquet. A table was prepared with pillows, on which the patient was laid on his face, the dorsum of the foot resting on the edge of the table. Everything necessary for the operation—bandages and dressings, were close at hand. I gave him a glass of wine, with Tinct. Opii, ♏xv, and proceeded to operate, seating myself with the foot before me.

"With a convex knife I made a longitudinal incision through the integuments, about four inches in length, over the middle of the tendon, raised the skin, and exposed the fascia, which I punctured and divided on a director to the same extent as the external wound. The edges of the wound were then held apart, that I might pass a small, pointed scalpel beneath the tendon; and this being done, the tendon was divided on raising the edge of the knife. Immediately the ends of the divided tendon were seen one inch apart. The patient was now placed on his back, when I grasped the foot with my right hand and endeavoured to flex it on the leg, having the index finger of my left hand in the wound between the ends of the tendon, that I might observe, on moving the foot, if the space between the divided ends were increased: but I could not move the foot more readily than before the division of the tendon, nor could I separate wider the ends of the tendon. I soon discovered, however, the reason: cicatrices had formed, which bound together the skin and tendon to the deep-seated tissues in the neighbourhood of the os calcis. The patient was again placed on his face, and I extended the incision as far as the extremity of the os calcis, divided the old cicatrices all around, and freed the tendon from the deep-seated tissues, which resembled a steatomatous mass rather than adipose tissue. The patient was again turned on to his back; and now I could bend the foot farther forwards, and separate wider the ends of the tendon, but the foot could not be restored to its normal position. Only a small quantity of blood was lost during the operation, and one small artery alone required a ligature. Small pieces of sponge, steeped in spirits of wine, were laid in the wound during the operation, that hemorrhage might not impede its progress. The tourniquet was now removed.

"Having fixed the knee, I grasped the foot with both hands, the thumbs being applied to the sole and the fingers to the dorsum of the foot. First, I extended the ankle; then, gradually increasing the force, flexed the foot as much as possible. Now my assistants held the foot firmly on the table, and I, with all my strength, applied myself suddenly to move the limb forward, which I accomplished, but with such cracking and noise as though all the bones were broken. The patient screamed terribly: the great pain, however, was soon allayed. On examining the foot, no fracture was found."

"Graduated compresses were placed on the calf of the leg, the whole leg was bandaged, and the foot was placed in a slipper to retain it in its new position.

"I was very apprehensive of the result, as the foot could scarcely have been restored without laceration of several of the ligaments, inasmuch as the great force which was applied caused the foot to yield suddenly, with a frightful cracking noise. Moreover, I was aware of the serious symptoms which are frequently induced by dislocations of the carpus and tarsus, when combined with laceration of the ligaments.

"This was certainly not a true dislocation: but it was treated as a compound dislocation, not only on account of the wound, but also on account of the rupture of several ligaments, which must necessarily have occurred.

"May 17th.—The patient slept quietly during some hours of the night.

"19th.—The pulse was frequent; there was loss of appetite, with thirst, headache, and pain in the foot: he had passed a sleepless night. The bandage was removed, the wound looked well, and was inclined to heal: another bandage was applied, in such a manner that it should not require to be moved to expose the wound.

"21st.—The upper half of the wound had nearly cicatrized; but some pus escaped from the lower portion.

"26th.—The pain was less, cicatrization was advancing.

"June 14th.—Except about the fourth of an inch, the wound had closed.

"July 18th.—I examined the limb, and found that anchylosis of the ankle was complete. The wound had not yet quite healed.

"27th.—Cicatrization was complete. He was allowed to walk about the room, which he did, bearing his weight on the foot without pain."[1]

Thus, this "successful restoration," of Sartorius, terminated in anchylosis. The case was less favorable for operation than that of Thilenius. It may well be matter of surprise that it terminated so favorably, when the treatment is considered.

Michaelis, surgical professor at Marbourg, operated, November 18, 1809, on a young man, sixteen years of age, for talipes equinus; and before the following October he had performed eight operations; namely, three for talipes equinus, one for varus, three for contracted knees, and one on a woman, thirty years of age, four of whose fingers were much contracted.

Michaelis was led to believe these contractions of limbs were curable, from considering the operation for torticollis, as well as by reflecting on Bell's operations, in which he divided Poupart's ligament. He did not divide the tendon in its entire extent, as had previously been done by Thilenius and Sartorius, but in part only, and ruptured the remaining portion, so as to restore the position of the limb.[1]

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[1] Siebold's 'Sammlung seltener und auserlesener Chirurgische Beobachtungen,' band iii.

Delpech, in 1816, next divided the tendo Achillis for talipes equinus, in a boy nine years old. Suppuration took place, and exfoliation of the tendon; abscesses also formed in the course of the thigh and in the groin, and several months elapsed before the limb could be used. It will be seen, on reading the case recorded by Delpech, that his mode of operating was a vast improvement on that which had been practised before his time: it was a subcutaneous operation, and may fairly be said to have been the commencement of subcutaneous tenotomy. The rules which he laid down, some years after, for the division of tendons, are absolutely those which guide the surgeon at the present day.

The Case of DELPECH, *in which he divided the Tendo Achillis.*

"In the month of March, 1816, I saw the son of a magistrate of this town (Montpellier), 9 years of age, for a deformity of the right foot, which had existed from birth. The foot was in a state of extreme extension, so that the toes appeared to point backwards; and when flexion was attempted, it was found to be impossible. It was, however, less difficult to increase the state of extension. When this was done, the motion was observed to be in the tarsal and metatarsal joints, rather than in the ankle-joint. The muscles of the leg and thigh were atrophied, but the length of the two lower extremities was equal. When the foot was placed on the ground, the toes and the heads of the metatarsal bones alone were in contact with the ground; but in walking, the foot inclined inwards, so that the fourth and fifth metatarsal bones formed the basis of support. The tendo Achillis was very tense.

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[1] Ueber die Schwächung der Sehnen durch einschneidung, als einem mittel bei manchen Gliederverunstaltungen,' in Hufeland und Himly's 'Journal der practischen Heilkunde,' v, Stück, 1811.

"This deformity was said to be congenital, but also that it had greatly increased since the period of infancy. The leg and thigh became daily more attenuated, and this increased as the deformity increased. No attempt had been made to remove this distortion; because to some it appeared incurable, and others expressed a hope that *equilibrium*, which they supposed to be destroyed, would be restored as age and development advanced.

"The age of the patient, together with the nature and extent of the malady and its long duration, held out no hope of success by those means which had been used efficaciously in other cases. The age when growth is most rapid, when nutrition is most active, and when extension is most easily borne, had already past. Also, it is infinitely more difficult to restore the shape of the foot when it is thus distorted, than when it deviates laterally.

"I have noticed, in every instance of rupture of the tendo Achillis which has come under my notice, that, notwithstanding the most methodical treatment, re-union is not immediately obtained between the divided ends, but that first a swelling is formed, which decreasing, gives origin to a prolongation or neck, which is smaller than the normal tendon. This cannot be otherwise accounted for than by the formation of an intermediate substance, which unites the ends of the tendon and occupies a certain portion of its length.

"It appeared to me that, with care, the length of this intermediate substance might be increased by gradual but continued extension, if it were applied before the substance had acquired all that firmness of which it is susceptible; besides, it is well known that neither the rupture nor the section of tendons, especially of the tendo Achillis, is attended by any serious result.

"With these impressions, I proposed that the tendo Achillis should be divided near the heel, leaving the skin which covers it *in situ*, and thus without exposing the tendon to the air or to the contact of dressings and bandages.

"It was quite certain that anchylosis had not taken place, that the tibio-tarsal articulation was more than sufficiently free, and that no obstacle would be presented to flexion of the foot, after section of the tendo Achillis.

"And the section being made, the foot might be held in the same amount of extension as before the operation, by a suitable apparatus; by means of which gradual but constant extension could be made, at the same time that the condition of the limb and the changes that might be taking place would be apparent to the surgeon; and also, through this means, the foot might be retained in the desired degree of flexion, until the intermediate substance had acquired that firmness of which it was capable.

"Re-union having taken place (and this could scarcely be doubtful), it was possible that extension might not be applicable, or it might not be practicable on account of the pain attendant on the operation. Should this be the case, the operation of dividing the tendon would prove useless, but, at least, it would not be dangerous; and the condition of the patient was such as to justify some risk. I was little apprehensive, however, on this account, for in solutions of continuity, it is always easier to obtain an imperfect union than a linear cicatrix.

"But it might also happen that the intermediate substance would not allow of the necessary extension; that it might break and not re-unite; or being fully extended, it might not gain that amount of consistence which is required of tendon. In either of these cases the result would be, that the use of the muscles of the calf would be lost; but the operation would not be altogether useless: the foot might be brought forward and fixed in that position, so that the sole of the foot should be in apposition with the ground. The gait would be imperfect, but less so than before. But it appeared to me that with attention unfortunate results of every kind would be avoided.

"Lastly, I have always observed that, when the shape of the foot has been restored by mechanical means and simple extension, the retracted muscles, as well as those which were relaxed, gain considerably in development. But by dividing the tendon, the muscle would be left in its retracted condition, and its nutrition would not be affected.

"After mature reflection, I considered the scheme to be practicable, and proposed it, mentioning, at the same time, my doubts to the parents of the boy. The proposal was talked over with several medical practitioners, who treated it with scorn; but, at the end of a month, it was determined that the operation should be undertaken: an apparatus was therefore prepared.

"May 9th, 1816.—I operated in the following manner:—The patient being laid on his face, the knife was passed from side to side in front of the tendon, so as to divide the skin on both sides to the extent of one inch parallel to the tendon. The knife was then exchanged for a convex bistoury, with which the tendon was divided transversely from before backwards, without injury to the covering skin. Having satisfied myself that the foot could now be flexed on the leg, I proceeded to fix the limb in the apparatus, at the same angle at which it was held before the operation.

"The pain was slight after the operation, and the patient would have slept well, had not the hand of a servant been placed on the limb to prevent movement.

"On the second day there was slight pain around the wounds, but the child was otherwise comfortable: this state of things continued until the tenth day.

"On the tenth day the wounds were exposed, without removing the apparatus, when a small quantity of pus escaped from them. After this, the ends of the tendon could be felt more distinctly; they did not appear to be separated by an interval; they were slightly swollen and painful. A pledget of lint was placed on the point of division of the tendon, with the intention of preventing another collection of pus, and to prevent the chance of ulceration of the integuments, which would have occasioned adhesion of the skin to the tendon.

"On the twelfth day, a considerable quantity of pus, together with shreds of tendon, escaped from the wound. After this, swelling of the tendon ceased, and the quantity of pus was diminished.

"About twenty days after the operation, namely, at the end of May, the wound on the inner side of the leg had closed, and that on the outer side had nearly healed.

"June 6th.—Twenty-eight days after the operation, the re-union appeared to be sufficiently complete to permit extension to be made, without risk of breaking the new substance. Extension was continued until June 9th. The intermediate substance had acquired one and a half inch in length, and cicatrization of the wounds was now nearly complete. In a few more days the foot was brought to a right angle with the leg, and it was maintained in this position one month, whilst solidification was advancing; at the end of which time, the tendon appeared to have gained all that length, fineness, and compactness of substance, of which it was capable: it had gained two inches in length; and this new portion of tendon was half the thickness of the tendon in its normal condition.

"A shoe was now worn, and the patient allowed to take exercise: he could stand on one or both feet, could walk and run without other deviation of the foot than a slight outward inclination.

"Such was the state of the patient, when derangement of the digestive organs supervened, and abscesses formed in the thigh, above the knee, and in the groin. He was sent without delay to Cette, where he used sea baths, which brought about the complete cicatrization of the wounds which had been made at the time of the operation; those, also, which were occasioned by the abscesses, as well as the tumefactions which resulted from them; and his health was in a short time completely re-established.

"At the present time, he is in the enjoyment of good health, and astonishes those who knew him previously, by the firmness and rapidity of his movements. He wears a proper support, which I intend he should continue to wear several years."[1]

Thus, the first and only operation performed by Delpech of tenotomy for the removal of distortion, was a subcutaneous operation. And, unlike his predecessors, he allowed re-union to take place before he commenced to make extension. It is much to be regretted that he who could write the following rules should not have had courage to resist the clamour which was raised against him, and practise that he had so well devised.

The rules of Delpech for the subcutaneous division of tendons.

"1st. The tendon to be divided should not be exposed: its section should be made by entering the knife at a distance from the tendon, and not through an incision in the skin parallel to it. There is danger of exfoliation of the tendon without this precaution is taken.

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[1] 'Chirurgie Clinique de Montpellier,' par le Professeur Delpech, tome i, p. 192, 1823.

"2d. Immediately after division of the tendon, the divided extremities should be brought into contact and so held by a suitable apparatus, until re-union is accomplished.

"3d. As re-union can only take place by an intermediate fibrous substance (*organisation inodulaire*), gradual and careful extension should be made, to give the required length to the shortened muscles, before solidification takes place.

"4th. Extension being complete, the limb should be fixed in this position, and there kept until the new substance has acquired that firmness of which it is susceptible.[1]

The author of these rules may well be said to be the originator of subcutaneous tenotomy. Fifteen years after the operation by Delpech, and three years after the publication of 'L'Orthomorphie,' Stromeyer first divided the tendo Achillis. Stromeyer was well acquainted with this work of Delpech, and approved of the rules therein inculcated. As Dr. Little has well said, "To Stromeyer is due the honour of establishing the division of tendons on a secure and permanent basis, and of ensuring its reception as a standard operation in the art of surgery." But, however great may be the merit of Stromeyer in reopening the question of tenotomy, it must not be forgotten that Delpech dictated what Stromeyer performed. The following case, the first in which Stromeyer divided a tendon for the removal of distortion, will show how well he had studied Delpech.

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[1] 'De l'Orthomorphie,' tome ii, p. 330, 1828.

Section of the Tendo Achillis for the cure of Club-foot.

"George Ehlers, aged 19, the son of a schoolmaster in Hanover, was affected, in his fourth year, with distortion of the left foot, from some unknown cause, which subsequently gradually increased in severity. At first, therapeutical means and bandages were tried with some degree of success; but the affection made such rapid progress, that this mode of treatment was found to be useless. Excoriations and deep-seated suppuration, inducing caries of the fifth metatarsal bone, resulted from these attempts to redress the limb. This treatment was consequently discontinued, and the boy, then 14 years of age, was provided with a wooden leg. With this he walked about tolerably well, using at the same time a stick or a crutch.

"In October, 1830, I was consulted.

"On the left side there was a severe form of club-foot; the toes were bent inwards and downwards, the outer edge of the foot was immediately beneath the axis of the leg, and the whole foot was forcibly extended through the action of the gastrocnemius muscle, so that the foot formed a continuous line with the anterior surface of the leg. Above the external border of the foot, were the rudiments of two callosities, which had been formed at an early period by pressure. A cicatrix, one inch long, and adherent to the bone, was observed above the fifth metatarsal bone. The motion of the foot was very limited. The leg was atrophied, and the calf very small, and drawn high up, and was only to be distinguished by moving the foot. From wearing a wooden leg five years, the leg had an outward inclination. The length of both legs was the same, allowance being made for this inclination. The muscles of the right leg were well developed.

"On the 28th of February, 1831, in the presence of Dr. Dommes, and some of my surgical pupils, I proceeded to operate. The patient was seated on a table before me, leaning towards the right side; an assistant fixed the knee, and another flexed the foot, and rendered the tendo Achillis tense. I passed a small, curved, pointed knife behind the tendon, two inches above its insertion, the back of the knife being towards the tibia, and its cutting edge so close to the tendon, that this was divided in introducing the knife, with a cracking noise. My intention of making the outer wounds as small as possible, to prevent the entrance of air, and to avoid suppuration and exfoliation of the tendon, was perfectly accomplished, for the point of the knife only passed to the opposite side, without producing a bleeding wound; and the point of entrance of the knife was only as broad as the blade itself. A very small quantity of blood escaped from the wound. The retraction of the tendon was very inconsiderable. When the foot was flexed, however, the ends of the divided tendon were three quarters of an inch apart, without the shape of the foot being appreciably improved; but when the foot was extended, no interval remained, the divided ends being in contact. The wounds were dressed with court plaster, &c.

"On the third day, the wounds had healed, the ends of the tendon were slightly swollen and sensitive, and there was slight ecchymosis about the inner malleolus. Movement of the foot did not influence the upper end of the tendon. On the sixth day, reunion had taken place, so that movement of the foot now stretched the upper portion of tendon. There was less swelling of the tendon, but considerable pain.

"On the tenth day, pain had almost ceased. Union was at this time so complete, that the patient could move his foot, and bring the muscles of the calf into action. The interval between the portions of tendon was now scarcely to be recognised. I thought that the time had now arrived when extension of the intermediate substance ought to commence; and consequently I applied the apparatus. When it was applied, the foot formed a very obtuse angle with the leg. Extension was in the first instance made very gradually, lest the adhesions should be broken, and also because more pressure caused pain; but at the end of a week more extension could be borne without pain. At the expiration of the eighth week, the foot formed a right angle with the leg; so I allowed the patient to have a boot, with an iron stem along its outer side, having a joint at the ankle, and a screw attached to it, to decrease the angle formed between the foot and the leg. With this boot, and the assistance of a stick, he could walk about the room. From long disuse, the leg at first swelled; but by using it daily, at first in the house, and afterwards in the garden, he gained strength and steadiness so rapidly, that in a fortnight from his first attempt he could walk a mile and a half. The length of the new tendon could not be distinctly made out; it was thinner only where the section had been made.

"At the end of two months the foot was at a right angle, and its outer edge horizontal. At the end of six months the position of the knee was entirely restored; and at the expiration of a year my patient was enabled to lay aside his boot and iron, and use an ordinary laced boot, in which he could walk securely without a stick, and so well that no one would have suspected the former condition of his foot, for he trod firmly and without effort, and brought the toes well forward, even when walking quickly.

"In the course of the following summer the foot was excoriated by wearing a new, tight boot; but there was no inclination to the return of distortion, and no tendency to retraction of the new substance. I therefore considered that the cure was complete."[1]

In a note appended to this case, Stromeyer observes:

"I determined the more readily to perform this operation, as, in September, 1830, whilst in Hamburg, at a meeting of the Association for the advancement of Science (Naturforscherverein), I was present at an amputation of the leg of a young girl afflicted with club-foot. Some of the most eminent German surgeons were present, and agreed on the necessity of amputation of the leg; yet the deformity was less than in my patient."

I have given these early cases of tenotomy *in extenso*, which now for the first time appear in an English dress, to show how slowly the advance was made from the "large wound" of Thilenius, and the frightful operation of Sartorius, to the more philosophical proceeding of Delpech, and the subcutaneous tenotomy of Stromeyer. Nearly fifty years were necessary for this purpose. But this triumph having been accomplished, the attention of the surgical world was directed to this new principle in surgery, by which unhealthy forms of inflammation were avoided, and adhesion was promoted.

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[1] Rust's 'Magazin,' band xxxix, p. 195, 1833.

In 1838, Stromeyer published his 'Contributions to Operative Orthopædic Surgery,'[1] in which the following occur as his rules for the performance of subcutaneous operations.

> "When it can be done, the tendons of the resisting muscles must be divided; but when the tendons can be divided only with great difficulty, then the muscles themselves. The section should be made beneath the skin, when this is possible, and the skin itself should not be divided. Small instruments of different shapes are to be chosen for this purpose; generally, a moderately curved, sharp-pointed knife is the most useful. The limb should be so held, that the tendon to be divided may be made to stand prominently forward; and the knife being passed behind the tendon, and the exit for the point of the knife being gained on the opposite side, the resisting tendon is to be divided rather by pressure against the edge of the knife, than by onward movement of the blade. The yielding skin follows on the blade of the knife, so that the two small wounds are only of the same breadth as the blade. I have very often divided the tendo Achillis with a single puncture of the skin; but this is unimportant, the two small punctures healing as quickly as one only. Usually, it is known when the tendon is divided, by a peculiar cracking noise at the moment of division. Section of the tendon with the point of the knife is not always safe; partly, because the point is not sufficiently strong, but, also, because other structures may be wounded should the patient not remain quiet. Probe-pointed knives are quite useless. . . . . When many tendons are to be divided the sections should, if possible, be made at the same time, for extension is then accomplished with greater facility than when the operation has to be repeated." [2]

After Stromeyer had led the way, and by his assiduity and skill had overcome difficulties and silenced his opponents, a crowd followed in his train. Some were content to perform the section of the tendo Achillis; others, again, saw in this new operation a mode of treatment applicable to deformities in general; of whom Dieffenbach was amongst the first to appreciate the subcutaneous section, and subsequently one of the boldest and most successful in its employment.

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[1] 'Beiträge zur Operativen Orthopädik,' Hannover, 1838.

[2] Op. cit., p. 18.

In the month of October, 1835, Vincent Duval performed, for the first time in France, Stromeyer's operation of division of the tendo Achillis.

In 1836, Dr. Little, who was himself afflicted with distortion of the foot (equino-varus), had, in June of the same year, the tendo Achillis divided, by Stromeyer, in Hanover, and the shape of the foot restored. Before he left Hanover, he himself performed a similar operation, in July, 1836; and subsequently, in Berlin, Dr. Little enlarged his experience by treating, together with Dieffenbach, numerous cases of distortion.

Dieffenbach's account of Dr. Little's return to Berlin, as "Apostel der Tenotomie," after having been operated on by Stromeyer, in Hanover, is worthy of its author.

> "A month had elapsed," writes Dieffenbach, "since Dr. Little had taken a letter from me to Dr. Stromeyer, in Hanover, when suddenly my door was opened, and the individual who had left me a cripple, entered with a vigorous, rapid step. I cannot tell which was greatest, my astonishment or my joy, but I think the latter. Without delay, I examined his foot, and found the shape normal, the sole in contact with the ground, the arch of the foot less; the calf of the leg had begun to be developed, and the entire lower extremity had gained its normal length. A miracle could not have struck me more forcibly; and I must confess that I was never in my life so taken by surprise at the successful result of a surgical operation as by this; and I esteemed Stromeyer, who had done it, even luckier than Little, who had been benefited by it."[1]

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[1] 'Ueber die Durchschneidung der Sehnen und Muskeln,' p. 80, 1841.

In Berlin, Dr. Little wrote his inaugural dissertation, and selected for his subject talipes varus.[1] He returned to England the same year, and we find, "February 26th, 1837, divided the tendo Achillis;"[2] and rapidly established that reputation which he now enjoys.

Delpech, in his master work, 'De l'Orthomorphie,' may well be said to have raised the structure—Orthopædy; it has, however, since his time, been greatly extended and simplified; and, amongst others, Dr. Little has contributed largely to its present advanced position.

It would be presumptuous in me to speak in terms of praise of the philosophical works of Jules Guérin. I would express an earnest desire that he may be induced to complete his valuable series of works, and that he may give to the profession, more in detail than he has hitherto done, the results of his labours. The name of Guérin will always remain prominent in orthopædy, and his writings a guide to warn against many shoals.

The decennial period 1830-40 is indeed rich in contributors to this branch of surgery. Such names as Bouvier, Ammon, whose work[3] merits the highest praise, Phillips, Held, Scoutetten, &c., enrich this period.

It is remarkable that subcutaneous tenotomy should not have been practised until 1831, as the subcutaneous division of muscles was introduced so long ago as 1670, by Roger Roonhuysen, and after him performed by Florian, Minius, Solingen, Meckren, Tulpius, Ten Hoof, and others, until the present time.

[1] 'Symbolæ ad Talipedem Varum Cognoscendum,' Berol., 1837.

[2] 'A Treatise on the Nature of Club-Foot,' p. 196.

[3] 'De Physiologia Tenotomiæ experimentis illustrata,' 1837.

CHAPTER II.

CONGENITAL TALIPES.

PHYSIOLOGY, DIAGNOSIS, AND ANATOMICAL PATHOLOGY.

THE term talipes, from *talus* and *pes*, was first used as a generic term by Dr. Little, and is applied to all those distortions in which the foot deviates from its normal direction, with and without partial displacement of the articular surfaces of the tarsal bones.

The following are the principal varieties of talipes; namely, varus, or inversion of the foot; valgus, eversion of of the foot; equinus, phalangeus, vel digitus, elevation of the heel; and calcaneus, depression of the heel. Of these several varieties there are many degrees: there are also compound varieties of distortion, which are composed of two of the above mentioned forms of talipes; as, for instance, equino-varus, equino-valgus, varo-equinus, calcaneo-valgus, calcaneo-varus, &c.

Each of these forms of distortion may be congenital or non-congenital.

Talipes varus is by far the most common form of congenital distortion of the foot. In a resumé of cases, which had occurred at the Royal Orthopædic Hospital, in 1851, it appears that, of 765 cases of congenital talipes, 688 were varus, 43 valgus, and 19 calcaneus.[1]

Equinus is an exceedingly rare congenital affection. It does not once occur among the above-mentioned instances of congenital talipes; and moreover Mr. Tamplin says, "I have never met with pure talipes equinus *congenital*."[2] It does, however, occasionally occur as a congenital affection; several authors relate cases which they have individually treated, and I have once seen an undoubted instance of congenital equinus.

Of non-congenital distortions, equinus, equino-varus, and valgus, are the most common: the latter is very frequently met with in a slight degree. In its more aggravated form, as it is usually seen at the Orthopædic Hospital, valgus is not the most common distortion of the foot. Of 1218 cases of congenital and non-congenital talipes, recorded by Mr. Lonsdale,[3] the varieties occur after the following order:

Talipes varus	583
„ Equino-varus	112
„ Equinus	226
„ Valgus	151
„ Calcaneus	50
„ Equino-valgus	40
„ Compound varieties	56
	1218

At the Orthopædic Hospital it is observed that double and single club-foot occur almost with equal frequency. Thus, of 688 cases, above mentioned, 363 were double club-foot, and 325 were single; and of these, 186 were of the right foot, and 139 of the left.

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[1] 'Medical Gazette,' Lecture by Mr Tamplin, 1851.

[2] 'On the Nature and Treatment of Deformities," p. 21, 1846.

[3] Lectures, 'Medical Gazette,' June, 1849.

In Paris, Duval finds, that the cases of single congenital talipes are to those in which both feet are affected as 2 to 1, as is shown in the following table:[1]

Congenital talipes.

Double	Males	35			45
	Females	10			
Single	Males		right foot 35	62	100
			left foot 27		
	Females		right foot 18	38	
			left foot 20		
Total					145

Talipes is probably a more common affection than is generally supposed. No fewer than 12,547 cases are reported as existing in France, or 1 in every 3000 of the population. And in England, I imagine that the number of cases, irrespective of cause, is relatively larger.

TALIPES VARUS.—Ῥαιβὸς, κυλλὸς, *varus, club-foot, klumpfuss, knollfuss, klopfuss, dohlfuss, pied-bot, stréphendopodie.* —This is the most common distortion of the fœtal foot, and it presents, even more than other varieties of talipes, degrees of distortion. The axis of the foot forms, with that of the leg, an angle, the anterior portion of the foot being inverted.

In the first degree of talipes varus the anterior portion of the foot is drawn inwards by retraction of the tibialis anticus. (*Vide* fig. 1 and 2.) This is by no means the most common form of varus, but this degree is essentially varus, as stated by M. Jules Guérin.[2] In this degree no other distortion is superadded to the twisting inwards of the foot, but in the other degrees the heel is raised, in addition to the inversion of the foot. Together with retraction of the tibialis anticus, the plantar fascia is occasionally shortened, through which the length of the foot is diminished.

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[1] 'Traité pratique du Pied-bot,' p. 327, ed. 2, 1843.

[2] Sur les Variétés Anatomiques du Pied-bot congénital,' p. 8, 1839.

Fig. 1.

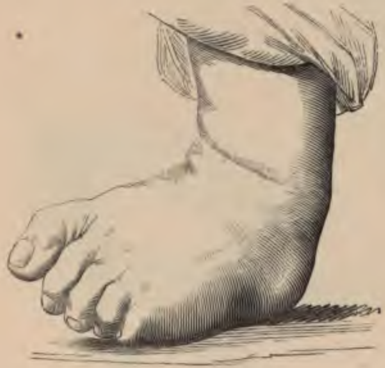
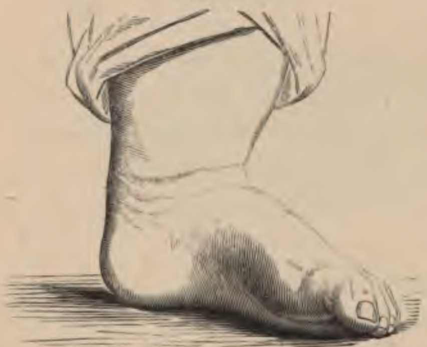
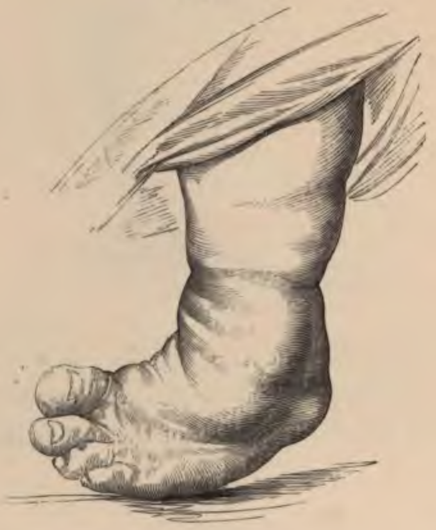


Fig. 2.



In the second degree, the inner edge of the foot is raised, the toes are inverted, and the heel is elevated. The position of the foot is such that a line extending in the long diameter of the leg, and passing in front of the tibio-tarsal articulation, will fall on the ball of the little toe. (Fig. 3.) The muscles of the calf of the leg and the anterior and posterior tibial muscles are retracted.

Fig. 3.



The third degree is the ordinary form of congenital varus: the foot is inverted, and the inner edge is so raised that the plantar surface describes a right angle or nearly a right angle with the horizon (fig. 4); the dorsum presents outwards, and the heel is elevated; the sole of the foot is shortened, and presents an unnaturally concave and irregular surface. (Fig. 5.) The first phalanx of the great toe is extended by M. extensor proprius pollicis, which is slightly retracted, and the extensor muscles of the foot and the adductors are more retracted than in the second degree.

The fourth degree is an exaggerated form of the last distortion. The toes present upwards and inwards; the

Fig. 4.

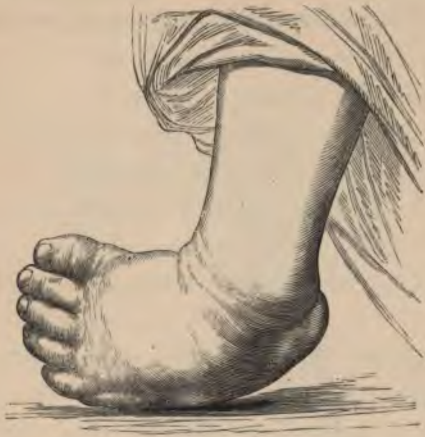
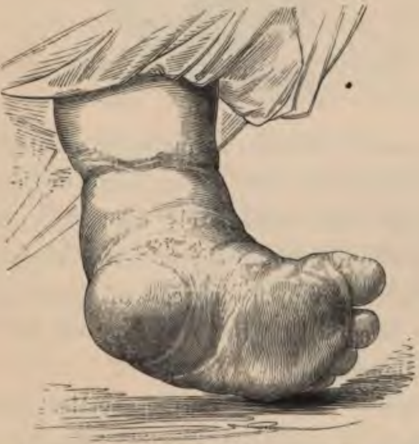


Fig. 5.

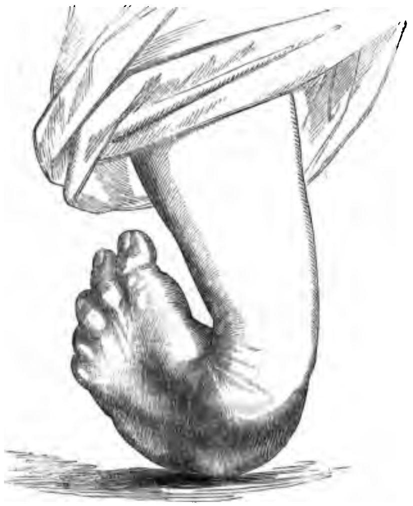


dorsum of the foot outwards and downwards, or forwards; the inner edge of the foot may lie in contact with the inner side of the leg, and the heel is drawn upwards and inwards. (Fig. 6.)

The flexors of the toes are rigidly retracted, as well as the extensors and the adductors of the foot, and also the muscles in the sole are found more or less rigid.

The abductors of the foot are extended; the plantar surface of the foot is abnormally concave, and the length of the

Fig. 6.



foot is diminished, the toes being approximated to the heel. The tendo Achillis is not to be found in the median line of the leg, but lies immediately above the posterior tibial vessels, on the inner side of the posterior surface of the leg.

In the third and fourth degrees of varus especially, the tarsal bones become rotated, by traction of the muscles, on their smaller axes.

The os calcis occupies almost a vertical position, being drawn upwards by the gastrocnemius muscle, and is also slightly rotated outwards.

The astragalus follows the calcaneum, and is slightly rotated outwards, it also undergoes displacement in its vertical axis; its inner surface tending to assume a direction forwards, and its external surface a direction backwards; and, by reason of its position between the malleoli, these are carried along with it, the internal malleolus being moved forwards, and the external backwards. The superior articular surface of the bone is imperfectly covered by the tibia; indeed, it may remain entirely uncovered by the tibia, and be thrown forward on to the dorsum of the foot. The astragalus being strongly articulated with the os calcis, is slightly rotated together with it: it undergoes consequently a twofold displacement; first, in its long axis, through its attachments with the calcaneum, and secondly, in its vertical axis.

The scaphoid bone is drawn inwards and upwards, and its tubercle may be in contact with the internal malleolus. And the cuboid, with the cuneiform bones, as well as the metatarsus and the phalanges, necessarily follow in the abnormal direction of the other bones of the foot.

The muscles which are principally concerned in giving rise to talipes varus are, tibiales, anticus et posticus, flexor longus digitorum, gastrocnemius, and soleus.

The plantar fascia is an important agent in the increase of distortion. It is very rarely alone shortened and without affection of the muscles, but it generally becomes secondarily affected; then it diminishes the length of the foot, and the span of the arch of the foot. It is, however, occasionally alone shortened at birth, but more frequently there is combined with it retraction of the tibialis anticus.

The tibiales are necessarily, from their attachments, mainly instrumental in the production of varus; they invert the anterior portion of the foot, and raise its inner edge from the ground: while the muscles of the calf of the leg raise the posterior extremity of the os calcis. It is this combined action of the extensors and adductors of the foot, together with the traction which is made on the calcaneo-scaphoid ligament, that causes rotation on its axis of the os calcis. And the astragalus is necessarily rotated with it; and also, through the elevation of the os calcis, is thrust forward on to the dorsum of the foot, and gains an oblique direction as regards the malleoli. The positions of these bones are due solely to muscular retraction; and their positions vary as muscular retraction is considerable or otherwise.

In the fourth degree of varus, the tarsal bones are not only twisted on their axes, but they are also sometimes wanting in development and are malformed. When distortion is induced at an early period of gestation, muscular retraction appears to be greater than when it occurs at a later period. The cartilages, then, accommodate themselves to the distorted position of the limb, and irregularities of form occur through abnormal pressure. These malformations of the tarsal bones occur only in severe forms of congenital varus; and in these instances some abnormality of the brain or spinal cord is generally found to coexist. In these cases, and also when distortion is less complicated, the patella is not unfrequently retracted above its usual position: it may be drawn up on the outer side of the thigh to the extent of from two to three inches. Occasionally, it is scarcely more than elementary in its development; once I have found it reduced to one eighth of its normal size; and in one instance it was absent. The following is the case, which I copy from my note-book:

"Oct. 1855.—H. T., æt. two months, was born at the eighth month of utero-gestation. Remained during three days after birth almost inanimate. From that time to the present has daily been convulsed, and several times in the course of the day. Is a poor, little, sickly, puny child.

"There is valgus of the left foot, of the third degree; and varus of the right, of the second degree, together with powerful retraction of the quadriceps extensor cruris, through which the leg is slightly bent forwards upon the thigh. After very careful examination, I was unable to discover any trace of a patella. They were both absent."

Duval mentions an instance in which the patella was absent, as follows:

"There is at present in my Orthopædic Institution a young child from Clermont-Ferrant, sixteen months old, who was born with extreme varus of the right foot, and equally well-marked equinus of the left. The flexor muscles are strongly retracted, and the toes are flexed on themselves; the tibio-tarsal, the tarsal, and the tarso-metatarsal articulations present almost a tetanic rigidity. In this child there is a development that I have never before observed, namely, absence of the patellæ."[1]

A spastic condition of the extensors of the leg is not an uncommon condition, together with the most severe form of club-foot; the knee can then only be partially bent, and the leg immediately returns to its extended position.[2]

Rotation of the tarsal bones is in rare instances so great, that their replacement becomes exceedingly difficult, yet dislocation does not occur, but rotation on their axes only. An instance of dislocation is, however, recorded, and the specimen is shown in the Strasburg Museum. The astragalus is dislocated inwards and forwards, and displaced transversely, with its posterior surface in contact with the malleolus externus.[3]

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[1] Op. cit., p. 95.

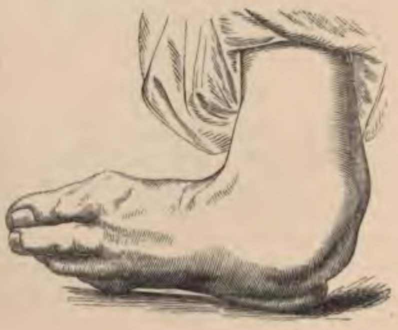
[2] Occasionally, retraction of the extensors of the leg continues to exist for many years. I have known it to exist at thirty years of age equally as in infancy. Congenital varus may be removed, and this distortion be suffered to remain, as, indeed, usually happens. I have once divided, with great advantage, the Sartorius at its origin, and the internal head of the rectus, in a case of this kind, where motion was impeded by retraction of the extensor muscles: the thigh was flexed on the trunk, and the leg was forcibly and rigidly extended.

[3] *Vide* Held, 'Diss. sur le Pied-bot,' 1836.

When the child begins to walk and to bear the weight of the body on the feet, important changes commence. The outer edge of the foot being alone in contact with the ground, a callosity, composed of fat and cellular tissue, is developed over the cuboid bone and the fifth metatarsal bone, for the protection of the skin, or over that portion of the outer edge of the foot which is in contact with the ground. A bursa mucosa is formed between the cushion and the bones, and a second bursa is frequently found between the cushion and the skin. These bursæ are apt to inflame through prolonged pressure; ulceration of the skin also occasionally takes place, and the callosity may be in part or wholly destroyed.

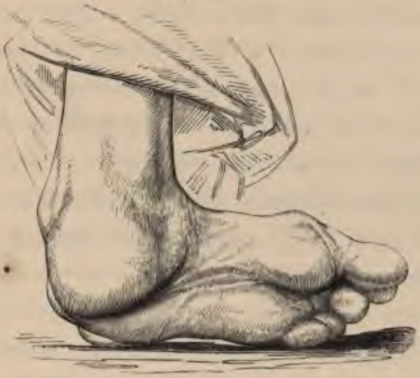
Pressure on the outer edge of the foot, to which the development of the callosity is due, occasions also rotation of the fifth metatarsal bone into the sole of the foot; for the surface being narrow for the support of the superincumbent weight, and the bone insufficiently supported, it yields and is pressed into the sole of the foot: the fourth metatarsal bone then, together with the fifth, the cuboid bone, and the os calcis, form the base of support. And in

Fig. 7.



like manner the fourth metatarsal bone may yield. In this way the transverse arch of the foot, which previously was unaffected, is compressed. (Figs. 7 and 8.) Now, it is not the outer edge of the foot alone which is in contact with the ground, but the dorsum. And distortion may even be increased beyond that which is now described. The weight of the body is now no longer transmitted to the ground through an arch, as in the normal condition of parts, but through a solid pile of bones; and, consequently, alterations in form are produced by attrition of the bony surfaces one upon another.

Fig. 8.



The scaphoid is, perhaps, more altered than any other tarsal bone in a case of long-standing congenital varus, being wedged in between the inner malleolus, the astragalus, the cuboid and the cuneiform bones. It undergoes atrophy through pressure (indeed, all the bones of the foot undergo atrophy, either through pressure or impaired nutrition), a new facet is formed for articulation with the inner malleolus, and occasionally this bone is found almost translucent, through the pressure of the head of the astragalus.

The os calcis becomes curved in its long diameter, the convexity presenting outwards. On the posterior half of its external face an articular facet is formed for the malleolus externus.

The cuboid bone assumes a conical shape, the apex presenting towards the sole of the foot; it is separated by a considerable interval from the os calcis. This bone is thought to be so important by Dr. Little in preventing the restoration of the foot in inveterate adult congenital varus, that he says, "the treatment might well be commenced in robust subjects by ablation of the os cuboides, which, in preventing the unrolling of the foot, acts as the keystone of the inverted arch."[1] The operation of ablation of the cuboid has been performed by Mr. Solly; inversion of the foot was overcome, and a useful limb was gained. I doubt whether this operation is ever necessary under forty years of age, and I should only deem it justifiable when other means had failed.

The cuneiform bones are less affected by pressure than by impaired nutrition; they are relatively smaller than in their normal condition, but their forms are little changed. They are rotated *en masse* with the anterior portion of the foot; the first cuneiform bone, however, is sometimes found to be rotated with the scaphoid by the tibialis posticus.

The tibia and fibula undergo atrophy, and the malleolus internus is shorter and more flattened than natural; it presents an articular facet, which corresponds with that of the scaphoid bone.

All the bones of the foot and leg become atrophied, and as age advances, degeneration of the bones takes place: this change, however, is more frequently connected with paralytic distortion than with the ordinary form of congenital varus. Concentric atrophy is, perhaps, more commonly seen; the periosteum becomes loosely attached to the bone, and the endosteum is softened and attenuated.

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[1] 'On the Deformities of the Human Frame,' p. 305, 1853.

These changes are incident to age. Also, anchylosis of the tarsus, rarely, occurs, or excrescences form on the head of the astragalus, for instance, which impede motion and prevent the restoration of the limb. But the change which is perhaps more than any other important, and which is common in long-continued distortion, is loss of elasticity in the ligaments. The rigid shortening of the ligaments is not unfrequently a serious impediment to the restoration of the shape of the foot in mature manhood, and greater than the changes incident to the bones.

The ligaments which are especially rigid and shortened, are—lig. deltoideum, plantare calcaneo-scaphoideum, calcaneo-cuboideum, plantare naviculare-cuboideum, plantare commune; and those which are most extended are—lig. fibulæ anterius, medium, et posticum, membrana capsularis ossis navicularis et capitis tali, and those on the dorsum, between the astragalus, scaphoid, and cuneiform bones. The plantar fascia, also, is always retracted.

Every muscle of the leg and foot is directly or indirectly affected, being either retracted or extended. Those which are most retracted are—M. gastrocnemius, soleus, tibiales, anticus et posticus, flexor longus digitorum, plantaris, abductor pollicis, transversus pedis, flexor brevis minimi digiti, flexores, longus et brevis, pollicis; and those which are most extended are—M. peronei, longus, brevis, et tertius, extensor longus digitorum, extensor brevis digitorum, abductor minimi digiti.

At an early period of distortion, the muscles alone are retracted, and the blood-vessels accommodate themselves by a series of curves to the distorted position of the limb. But after the lapse of years, when structural change and shortening have resulted, the vessels and nerves likewise are found to be essentially shortened. At the same time that the muscles undergo structural change, the fasciæ lose their glistening appearance; the ligaments soften and lose their elasticity; the tendons diminish in size, and the blood-vessels in calibre; the nerves become as though reduced to their neurilemma; and the skin no longer retains its smoothness and elasticity.

The following is the report of Cruveilhier of a dissection of congenital varus from a female, aged 41, the limb having been injected through the popliteal artery:

"The thigh on the side of the distorted foot was nearly the same size as the other thigh, but the leg was atrophied. The subcutaneous layer of fat was of considerable thickness. The skin was hard, the dermis being thickened; and over the tuberosity of the calcaneum, which projected considerably, the cuticle was deposited in several layers. An irregular synovial capsule allowed the skin to move freely over the tuberosity. The skin of the sole of the foot was thin, as that which has not been subjected to friction. The aponeurosis of the leg was much thinner than usual, and had in part lost its glistening appearance. The nerves, especially the muscular branches, were extremely small, as though reduced to their neurilemma. The tibial arteries had not half their usual calibre, and only one muscular branch was injected. The veins, in like manner, were diminished in size. All the muscles had passed into a state of fatty degeneration—the tibialis anticus, extensor longus digitorum, the peronei, longus et brevis, the soleus, and the external head of gastrocnemius; and the tendons themselves were very much attenuated. The tendo Achillis was certainly not half the size of that of the other leg; and the aponeurosis, having undergone a similar amount of atrophy, showed that exercise is as necessary to the tendons and fasciæ as to the muscles. The traction which the muscles make on their tendons during contraction is the exercise that is requisite for them, and the distension which is caused by the same contraction is that which is necessary to the aponeuroses."[1]

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[1] 'Anatomie Pathologique,' tome i, livraison 2, 1829-35.

Talipes valgus.—*βλαισὸς, valgus, plattfuss, splay-foot, pied-plat, stréphexopodie.*

Valgus is, in some sort, the reverse of varus, inasmuch as the adductor muscles are retracted in varus, but the abductors, in valgus.

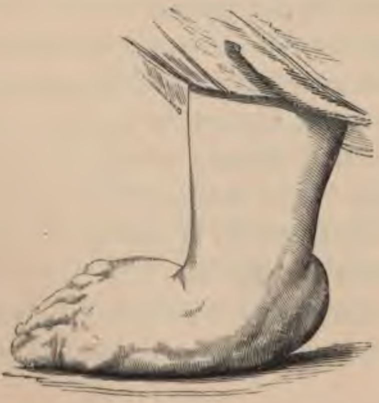
In valgus the foot is everted, the arch of the foot is lowered or lost, and a convex surface may present instead of the normal arch; the outer edge of the foot is raised, and the plantar surface is inclined outwards; the malleolus internus is consequently rendered unusually prominent, and brought nearer to the ground; the toes are extended, and the knee is inclined inwards. Such are the general characters of valgus.

Three grades of distortion may be distinguished.

In the first degree the peronei muscles are alone retracted, through which the motion of the ankle-joint is impeded, and the foot is everted and rotated outwards. This is a rare form of congenital affection, and far less common than the second degree.

The second degree is that which usually exists as congenital valgus. (Figs. 9 and 10.) M. peronei, longus, brevis

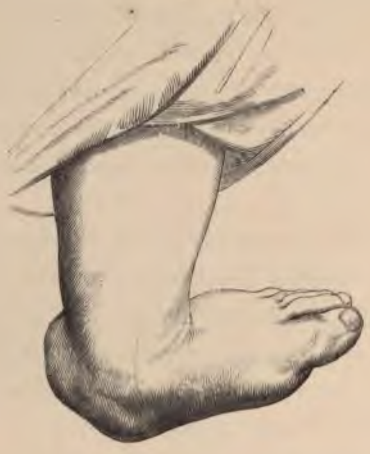
Fig. 9.



et tertius, extensor longus digitorum, gastrocnemius, and soleus, are retracted. Very rarely the extensors of the foot are not retracted.

In the third degree, in addition to the muscles above mentioned, M. tibialis anticus, extensor proprius pollicis, and abductor minimi digiti, are also retracted. In this grade of valgus the muscles of the calf of the leg are always retracted, and the heel is in consequence raised; but the anterior portion of the foot is flexed on the leg by the action of the muscles on the anterior surface of the leg; consequently the ankle-joint is locked, the arch of the foot is destroyed, and the plantar surface presents a convex, instead of its normally concave surface. The dorsum of the foot is hollowed out on its outer aspect, and lies in contact with the external and anterior surfaces of the leg. (Fig. 11.) This degree of distortion is rare, and when it exists in both feet is usually combined with monstrosity. Extreme grades of distortion,

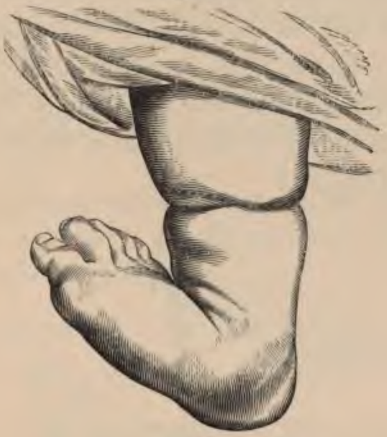
Fig. 10.



valgus of one foot and varus of the other, for instance, are more frequently met with than double valgus of the third degree.

There is rarely any real displacement of the tarsal bones in valgus, nor is there any deviation observed from the normal forms of the bones. The metatarsal bones are first affected by the retracted muscles, and later the cuneiform and the scaphoid bones undergo slight rotation. The scaphoid bone is drawn downwards and forwards, and comes prominently into view on the inner side of the foot, the astragalus and os calcis are tilted inwards, and the plantar arch is obliterated; a depression is formed beneath the outer malleolus by eversion of the foot and elevation of its outer border. The astragalus becomes slightly twisted in the articulation, and may even not be opposed to the inner malleolus; the fifth metatarsal bone, and the external surface of the os calcis present upwards, and the plantar surface of the foot outwards.

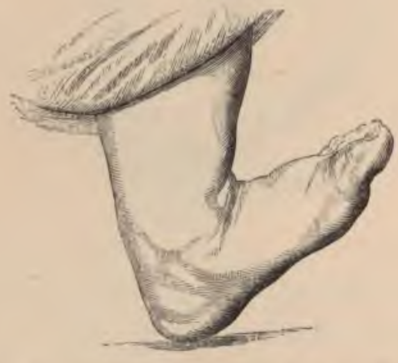
Fig. 11.



TALIPES CALCANEUS.—*Talus, hook-foot, heel-foot, hakenfuss, pied-bot calcanien, stréphanopodie.*

In congenital talipes calcaneus the foot is flexed upon the leg and the heel is depressed. Flexion may be so complete that the dorsum of the foot shall be brought into contact with the anterior surface of the leg; or, on the other hand, the foot may be only slightly flexed beyond a right angle. The muscles which occasion this distortion are extensor proprius pollicis, extensor longus digitorum, and tibialis anticus, and, in severe grades of distortion, M. peroneus tertius. (Fig. 12.)

Fig. 12.



Of the four principal varieties of talipes, this is the least important: it is also removed with the least difficulty. There is neither malformation nor displacement of the bones in this distortion, but it is an abnormal degree of flexion of the fœtal foot which is retained as a permanent position. It occasions, in its highest degree, considerable extension and debility of the muscles of the calf of the leg, which may continue for some time after the removal of the distortion. Power, however, is gained by allowing the muscle to contract upon itself. From debility of the opponent muscles, and, doubtless, in some instances, from a continuance of irritation, this distortion (as indeed every form of congenital talipes) is liable to recur after the restoration of the foot to its normal position; but there is no form of talipes which is more easily removed, nor, after removal, in which the foot is more easily retained in its normal position, than calcaneus.

The posterior portions of the lateral ligaments of the tibio tarsal articulation are extended in this form of talipes.

TALIPES EQUINUS.—*Pes equinus, talipes digitus, horse-foot, ox-foot, spitzfuss, pferdefuss, pied equin, pied-bot phalangien, stréphocatopodie.*

This is an extremely rare form of distortion. It consists of permanent extension of the foot without abduction or adduction.

The only undoubted instance which I have seen of congenital talipes equinus has occurred since the publication of a series of papers in the 'Medical Times and Gazette,' in which congenital equinus is thus spoken of:

> "I should, with my colleague, Mr. Lonsdale, have said, that talipes equinus never occurs as a congenital affection (never having seen an instance of this variety of talipes which had existed at birth as a simple distortion, and without retraction of other muscles, whether adductors, abductors, or flexors of the foot), had not instances been recorded and figured by Ammon, Duval, Guérin, Dr. Little, and others: but, in consequence of their testimony, I will describe this as the rarest form of congenital talipes."[1]

In the case above referred to, and which I saw within a week of the birth, the distortion was observed at the time of birth. Anxiety had occasioned premature labour; namely, at the eighth month. The child was born with talipes equinus of the left foot, without either adduction or abduction of the foot; the heel was raised half an inch; the tendo Achillis was tense; the convexity of the dorsum and the concavity of the sole of the foot were increased, and the toes were slightly flexed. The plantar fascia was not shortened.

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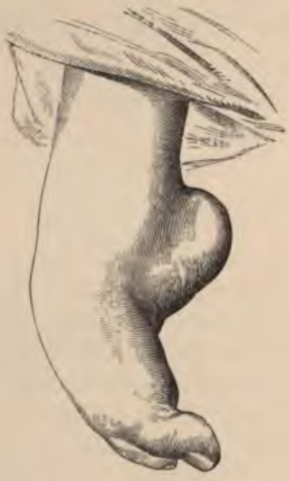
[1] Contributions to Orthopædic Surgery, 'Medical Times and Gazette,' p. 414, vol. ix, 1854.

There is also at the present time in the Orthopædic Hospital, under the care of my friend and colleague, Mr. Lonsdale, a child with spasmodic congenital equinus of one foot and equino-varus of the other. For the following particulars I am indebted to the Rev. William Charles Fox, M.B., under whose auspices the child was placed in the hospital:[1]

Fig. 13.



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[1] In adducing this as an example of congenital distortion, I must state, that Mr. Lonsdale expresses some doubt as to the congenital character of the affection.

"D. W., æt. 3, was admitted into the hospital, October, 1855: he is a fair child, plump, and pale.

"His mother asserts, as well as others who have known the child from birth, that he was born with the distortion as it now appears, and that distortion has neither increased nor diminished since birth. The child has never had a fit, nor does other known cause for distortion exist.

"The fore-arms are slightly extended by retraction of M. triceps; the hands are prone and extended on the fore-arms, and the fingers are flexed; the legs are extended on the thighs; the left foot is affected with equino-varus, and the right with equinus; the boy speaks very slowly, and stammers; the urine and fæces are passed involuntarily.

"The right foot offers an excellent example of congenital spasmodic equinus; the heel is drawn up, the arch of the foot is increased, the toes are flexed." (See fig. 13.)

Talipes does not, however, always appear as varus, equinus, valgus, or calcaneus, but occasionally a compound distortion is produced, which partakes of two of the above-mentioned varieties; as, for instance, equino-varus, in which the heel is more elevated than is usual in varus, and the foot is less inverted than in the third degree of varus; and, again, equino-valgus, in which also the heel is unusually elevated: both of these varieties are, however, uncommon congenital affections. Again, calcaneo-valgus, which is perhaps the most common compound form of congenital distortion, and also calcaneo-varus, which is the rarest, require to be named. It is scarcely necessary to enter into a special description of these compound varieties, as all that relates to them is comprised in the descriptions of the simple varieties, and their characters are marked by their distinctive appellations.

CHAPTER III.

THE ETIOLOGY OF CONGENITAL TALIPES.

The question, "what is the cause of congenital club-foot?" has developed a variety of opinions.

Ambrose Paré believed that the distortion was occasioned by the mother sitting cross-legged. Walther, that varus was a natural condition of embryo development. Camper, Glisson, Blumenbach, Naumberg, Wanzel, and Tourtual, that it was induced by deficiency, abnormality, or displacement of the astragalus or other tarsal bones. Scarpa believed that the bones were slightly deformed and twisted on their axes; that they were first affected, and that the muscles subsequently became shortened in consequence of the changed positions of the bones. Delpech says, "from a cause unknown to us, the forms of some, or all, of the bones of the tarsus are altered; hence the deviation of a part of the foot, the lengthening of some muscles and the shortening of their antagonists."[1] Delpech, however, subsequently withdrew this opinion, and asserted that the muscles were the cause of distortion.[2] Palletta thought he had discovered the cause in the deficient size of the malleolus internus. Benjamin Bell believed curvature of the tibia to be a predisposing cause. Béclard, that paralysis of the abductor muscles was the cause of varus. Du Verney and Jörg, that the unequal tension of the muscles and ligaments occasioned rotation of individual bones and of the whole foot. Maisonnabe, that the shortened condition of the plantar fascia was the sole cause. Boyer, Cruveilhier, Martin, Chaussier, Breschet, conclude that malposition in utero, is the cause. Rudolphi, Stromeyer, Guérin, Little, believe in nervous influence occasioning abnormal contraction and consequent distortion.

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[1] Chirurgie Clinique,' p. 197, tome i.

[2] 'De l'Orthomorphie,' §§ 116, 117, tome i.

These several opinions may be classed as follow:

1st. Malformations and displacements of the tarsal bones.
2dly. Affections of the muscular system.
3dly. Malposition in utero.
4thly. Disordered nervous influence.

Are the bones in club-foot primarily affected?

Scarpa says:—It can be proved, beyond a shadow of doubt, that the abnormal twisting of the tarsal bones first takes place, and that consequently some of the muscles become shortened, while others are lengthened." [1] But, notwithstanding his assertion, he did not prove his position. The above-quoted sentence was written in answer to a statement made by Du Verney, that—"These distortions depend entirely on the unequal tension of the muscles and ligaments; those which are extremely tense drawing the parts towards them, while their antagonists yield, being relaxed." [2]

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[1] 'Memoria Chirurgica sui Piedi torti Congeniti dei Fanciulli,' p. 32, 2d ed., 1806, Pavia.

[2] 'Traité des Maladies des Os,' ch. iii, tome ii.

It may safely be said that the tarsal bones are never primarily affected; but, being acted on by the muscles, are twisted on their axes, and through abnormal pressure at an early period of fœtal existence, development is impeded, and the shapes of some of the bones may be altered.

But although the muscles are the agents which produce these congenital distortions, it cannot be said, with Du Verney, that "these distortions depend entirely on the unequal tension of the muscles and ligaments." The muscles are doubtless the agents through which the tarsal bones become rotated, but being themselves under the influence of the nervous system, other agency than that of the muscles and ligaments is involved in the production of congenital distortions.

Can position of the *fœtus in utero* ever be the cause of club-foot?

Cruveilhier, a great authority on all questions of pathology, asserts, that position in utero is the sole cause of these distortions. He reasons thus: club-hand and club-foot are analogous affections; club-hand ceases at birth; it is therefore caused by a cramped position *in utero*: and the affections of the hand and foot being of the same nature, their causes are also identical: ergo, pressure *in utero* is the cause of club-foot. But his premises are false. So far from club-hand ceasing at birth, it usually continues to exist for months, and frequently for years.

Rudolphi was the first who took a more correct view of the subject. He writes:

"I presume that club-hand and club-foot in the fœtus arise alone through morbid nervous influence on the muscular system. Those who believe in an extrinsic, mechanical cause, as pressure, through malposition, cannot be aware that these distortions have frequently been found in the embryo of the third and fourth months."[1]

Here, then, is the answer: it is impossible that pressure should affect the fœtus of three months, and produce distortion.

Specimens are not wanting of these distortions in the fœtus of three or four months, and in which the liquor amnii was abundant. And also, it is well known, that deficiency of the liquor amnii in no measure entails distortion.

Doubtless, the cause of club-foot must be sought elsewhere than in the muscles or the bones, or in any extrinsic cause: for considering the manner in which the fœtus is packed in the uterus, the head being bent upon the breast, the neck and back curved forward, the thighs flexed upon the trunk, and the legs upon the thighs, the arms folded on the thorax, and the fingers into the palm, and such the normal position of the *fœtus in utero*, it is evident that, if position were an element occasioning distortion, club-foot and every other form of muscular retraction would not be the exception, but the rule.

To come, then, to the last category. Is club-foot occasioned, as Rudolphi states, by a morbid nervous influence acting on the muscles?

It is found that club-foot, and every other form of distortion, is frequently met with in the fœtus, where there is some deficiency, or a marked change from the normal condition of the brain or spinal cord. In the anencephalic monster, for instance, and in the fœtus affected with spina bifida, not only is distortion of the feet most common, but,

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[1] 'Grundriss der Physiologie,' p. 323, band ii, 1823, Berlin.

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especially in the former, there is found every known form of muscular retraction; such as scoliosis, torticollis, strabismus, talipes, club-hand; luxations of every kind, complete and incomplete, of the patella, the knee, the femur, the jaw, the shoulder, the elbow, &c. In all these forms of distortion, muscular retraction exists in a degree equal to the amount of distortion. The spine may be curved laterally, to so great an extent as to diminish by one third or more the height of the trunk. Or, the muscles of the back of both sides being simultaneously retracted, the occiput may be drawn down to approach the sacrum. Or, the extensors of the leg may cause the leg to be bent forward upon the thigh; and, in the same manner, retraction of the triceps may draw the fore-arm backwards upon the arm. And, together with these distortions, talipes will probably be found to exist in some severe form.

Cause and effect, in these cases, then, are demonstrable.

Again, a second series exists, in which are included hydrocephalic and hydro-rachitic fœtuses, where a similar result is observed as in the last-mentioned category; namely, luxations and sub-luxations, with muscular retraction in every form.

And, also, similar distortions are found to exist with traces only of cerebral and spinal disease, the degree of distortion, and its extent (implicating one or many limbs), bearing some relation to the amount of disease present. But, also, it is certain that the lesion may be of such a nature as not only to elude search, but to be entirely removable; and this, both when it occurs as a congenital and as a non-congenital affection.

Except in those instances in which distortion is slight, the nutrition of the fœtus is imperfect. The full period of gestation is seldom attained, but it is generally terminated at the seventh or eighth month. Defective nutrition is probably due to spastic action and to the cause giving rise to it, namely, irritation or disease of the nervous centres.

Mental emotion, whether fear, anger, intense joy, or grief, is probably one of the causes of the spastic affections of the *fœtus in utero*. The changes which are induced in the blood and secretions of the fœtus, by emotion in the mother, or any continued derangement in the system of the mother, are probably sufficient causes to induce convulsive action in the embryo.

An example is related by Tourtual of emotion causing the maternal secretions to become prejudicial to, and occasioning the death of, her infant.

"During Easter, 1821, a carpenter of this place (Munster) quarrelled with a soldier, who was billeted on him, when the latter fell upon him with his drawn sword. The carpenter's wife, at first, trembled with fear and horror; then, suddenly throwing herself between the combatants, she wrested the sword out of the soldier's hands, broke it, and flung it away. Some neighbours, attracted by the noise, hastened to the spot, and separated the men. The mother, thus violently excited, and while this mad uproar still continued, took up her child from the cradle where it was playing, and gave it the breast. The infant was in perfect health, and had never had a moment's illness. After some minutes it became restless, and left off sucking; it panted, and sank dead in its mother's lap. A quarter of a hour had scarcely elapsed when I saw the child. It was as though sleeping undisturbed in its cradle, and the body had not yet lost its natural heat. I immediately applied all the resources of my art (although I could not understand why death should take place so rapidly from such a cause), but in vain."[1]

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[1] 'Praktische Beiträge zur Therapie der Kinderkrankheiten,' Münster, p. 94, 1829.

Again, the following case came under my own observation :

E. B., æt. 17. When nine months old was being suckled by her mother, at the time that intelligence was received of the sudden death of her father at sea. The mother was naturally much affected on receiving this unexpected and sad intelligence. Two or three days later she was alarmed by her child shuddering and fainting in her arms without any apparent cause. These attacks were repeated, returning at short intervals, and terminated in convulsions ; the toes were drawn downwards and the feet inwards, and the hands were clenched. At two years of age, these fits became less frequent, and assumed the ordinary character of epileptic attacks. The extensors and adductors of the feet, and the flexors of the fingers were slightly but permanently retracted. At seventeen years of age she was robust and healthy in appearance ; but the memory had suffered, and the temper was irritable. The epileptic attacks had assumed a periodical character, and preceded the catamenia ; the pronators of the right forearm were spasmodically contracted, and the flexors of the fingers ; the gastrocnemius, soleus, and tibialis posticus were also affected in the same manner.

And it cannot be doubted that, during the more intimate relationship which exists between the parent and embryo, a less cause even may produce a similar effect. It is impossible not to believe that, while the relation between the two is so intimate that the fœtus is to all intents a part of the maternal body, a comparatively slight cause may induce a diseased action.

It is scarcely necessary to mention, that the siege of Landau, and the explosion of the arsenal, was, as we are assured by most credible witnesses, followed by the most dire effects on both mothers and children. Of ninety-two children who were born soon after, fifty-nine died at birth, or were born dead, or survived only some few months ;

and some were idiotic, and some were born with fractures of the bones.

I have known so many instances in which emotion has been the cause of derangement in the system of the fœtus, and cause and effect been recognised and acknowledged in some at the time of their occurrence, and without waiting for demonstration of the effect until the termination of gestation, that I cannot doubt its influence.

For instance, the wife of a shopkeeper, a highly respectable and intelligent person, had occasion to take her child to a surgeon for his opinion of some slight ailment with which it was affected. She was at the time in the sixth month of pregnancy. On entering the room in which the consultation was held, she observed several casts of club-feet and other distortions, and was immediately seized with a sensation of disgust, followed by sickness and general *malaise*. She was removed home, when she expressed her conviction that she should give birth to a child with clubbed feet, in consequence of what had occurred. She did not entirely recover from the impression which had been produced until after the child was born, namely, one month after the occurrence, *i. e.*, at the seventh month of utero-gestation. The child was born with double varus of the third degree.

One of the worst forms of club-hand and club-foot that I have ever seen, unconnected with monstrosity, was believed by the mother to have arisen in the following manner:

During the sixth month of pregnancy, the wife of a substantial Lincolnshire farmer, early in 1852, had a narrow escape from falling into a deep dyke, in which were eight or nine feet of water. She saved herself by dint of a great muscular effort, and sustained, at the same time, a very severe fright. Until this occurrence, she had felt the ordinary movements of the fœtus, but from this moment they ceased entirely, so that she expressed her belief that the child was dead. Until the fourth day no movement could be distinguished; but on that day a slight fluttering or tremulous motion was felt, which increased, until in time it was similar to that which had been felt before the accident. The child was born at the eighth month with talipes varus and talipo-manus, and was small and unhealthy in appearance.

The hands remained distorted long after the feet had been restored to their normal shapes.

The following case was under the care of Mr. Tamplin, at the Orthopædic Hospital, to whom I am indebted for it:

"During the sixth month of pregnancy, a robust woman fell, in the dusk of the evening, into an opening which had been left uncovered in the road. She was much alarmed and somewhat hurt by the fall. The child was born at the eighth month, with the hands and feet as shown in the accompanying engravings."

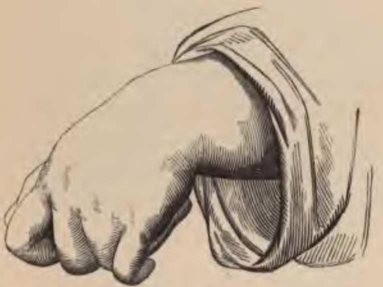
Fig. 14.

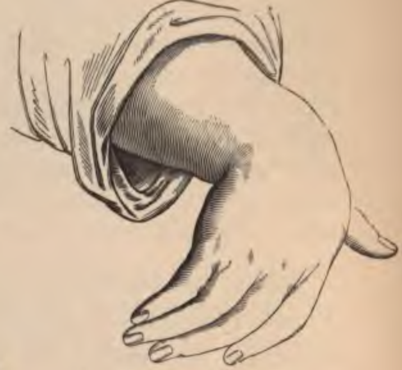
Fig. 15.

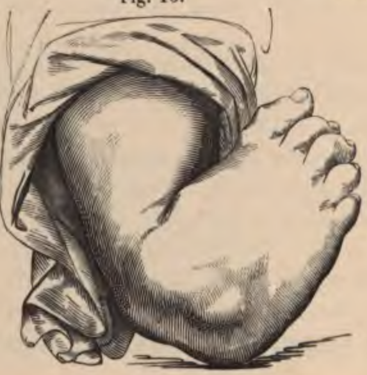
Fig. 16.

I could mention many cases in which the mother remembered to have been particularly struck by the appearance of a club-foot during her pregnancy, and which she believed, from the impressions it had occasioned, was the cause of distortion in her own child. In one case, an unfortunate beggar, whose feet where distorted into varus; in another, a boy with club-foot beating her child, were mentioned by the parents as the probable causes of distortion of the infants of which they were at the time pregnant. Or again, an injury to the foot of the parent is occasionally assigned as the cause of distortion in the fœtus.

Again, many cases occur for which causes cannot be with any degree of certainty assigned; and it is probable that in hysterical and highly sensitive persons, a cause, which, under ordinary circumstances might be insufficient, may in these prove sufficient to induce convulsive action in the fœtus, or to induce spasm of individual muscles or of groups of muscles. Although much obscurity must veil this part of the subject, it is generally accorded that the poor and the uneducated—those who are exposed to care and want, or to brutal treatment, intoxication and vice, are more subject to these affections than those differently circumstanced. Mental impressions, unrestrained and violent passions, brutal treatment involving personal injury and creating fear, are, I believe, common causes of these affections.

Congenital distortions are sometimes hereditary. In 1853, I operated on a child for talipes varus of both feet, who had three brothers, all of whom were born with double varus; and in 1855, a fifth boy was born in this family, also with varus of both feet, who also was under my care, and on whom I operated. There were three girls in this family born intermediately with the boys. None of them, however, were in any degree distorted. The father of these children and his brother were both of them born with double varus, and also their grandfather. In each generation there were females in this family, but amongst them no instance of distortion.

Duval mentions a somewhat similar example, showing the hereditary nature of these affections, in which three brothers were born with club-foot, whose maternal grandmother was also similarly affected. Also, two girls, whose paternal grandfather was in like manner affected with congenital varus.[1]

Held mentions a family of six children, all of whom were born with club-foot; and one of the parents was also similarly affected.[2]

Dr. Little says:

> "It may be remarked as a contribution to the etiology of congenital distortions, that the parents of children born with varus, for example, often present uncommon convexity of tarsus without contraction of leg muscles, and without appreciable deformity, or they, and their fathers before them, have been particularly accustomed to turn in their toes. They have what may be considered a small element of calcaneo-varus or of varus; viz., unusual concavity of sole, probably due to some unusual tension of plantar muscles, or some undue tension of posterior leg muscles. But in accordance with the observed law in physiological pathology, that parental derangement is reproduced in the progeny in increased intensity, unless counteracted by another law which regulates the union of the sexes, but which it is unnecessary to enter upon here; the child is born not simply with an affection dependent upon slight undue tension of plantar or other muscles (as in the parent), but presents increased disorder of nervous and muscular systems, severely involving muscles of the leg, as well as of the sole, and consequent varus."[3]

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[1] Op. cit., p. 111, 2d Ed.

[2] Op. cit., p. 41.

[3] Op. cit., note, p. 308.

Others, such as Scoutetten, Ivernois, &c. have recorded instances of hereditary varus. At the Orthopædic Hospital several instances have come under my observation of a parent and one or two children thus afflicted.

Children who are born with these distortions are frequently subject to convulsive disorders. And the recurrence of distortion after its entire removal, whether by operation or mechanical treatment, indicates the persistence of nervous irritation. There is an inclination to the recurrence of distortion after restoration of the limb in every instance of congenital distortion. Occasionally, it returns suddenly at the moment of an epileptic seizure, or on the child being convulsed, as in the following case.

February, 1852.—I divided the tibial tendons and the tendo Achillis of a strong plethoric infant, fourteen months old, for the removal of congenital varus. Both feet were nearly equally distorted. I had scarcely commenced the operation, when the child, crying violently, was seized with a fit; and I then learnt that, when seven months old, the child had hooping-cough, which was followed by a succession of slight fits; and that, at intervals, on coughing or crying violently, the fits recurred. The feet were after some months perfectly restored, and the supports were at length removed and discontinued. Seventeen months after the operation the child again had a fit, when both feet were drawn into the same distorted positions as at birth. The father of this child was epileptic.

An example of the recurrence of distortion from cerebral excitement is recorded by Guérin. M. Jules Guérin, says:

"I had to treat twins who were affected with double congenital varus. I entirely removed the deformity, and the treatment had been concluded six months, when one of them was seized with a cerebral affection which brought back the club-feet; so that in three days they were just as they had been before the treatment was commenced. I again treated and cured them; and, as though further to prove the relation of cause and effect, one year later the same child was seized with convulsions, less violent than previously, and one foot again became clubbed, that one, namely in which distortion had been greatest. On this occasion the foot was less distorted than previously. At these three periods, viz., at birth, and after the first and second cerebral attacks, the foot presented the same form and anatomical peculiarities. At birth, these children appeared perfectly healthy, and this distortion of the feet was the only trace of the intra-uterine affection which had occasioned it."[1]

I have observed that congenital distortions are occasionally, almost, or entirely, overcome during sleep, and that the limb regains its normal position; but that the distortion recurs at the moment of waking: but also I have observed that during sleep the muscles are frequently twitched to draw the limb back again into its distorted position. I have only observed this of the hand and foot, and only in some few instances; yet I deem the facts to be sufficiently important to be recorded. I have also occasionally observed the same relaxation of the retracted muscles to occur under the influence of chloroform.

In conclusion, it may be summed up in few words, that congenital distortions depend on irritation of the cerebro-spinal nervous system, or on inflammation or destruction of parts of that system.

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[1] 'Mémoire sur l'Étiologie Générale des Pieds-Bots Congénitaux,' p. 22, Paris, 1838.

CHAPTER IV.

NON-CONGENITAL TALIPES.

ETIOLOGY, PHYSIOLOGY, DIAGNOSIS, PROGNOSIS, AND PATHOLOGICAL ANATOMY.

THE various forms of non-congenital talipes are known by the same names as the analogous congenital distortions: there are, however, material differences, although certain points of resemblance, which render the diagnosis of these affections simple.

Non-congenital distortions depend on many causes, but chiefly on structural or functional changes in the nervous system, and on paralysis of a single muscle or of a group of muscles. For the sake of convenience they may be distributed under the following heads, viz.: *paralysis*, *spasm*, *inflammation*, *voluntary position*, and *debility*.

Non-congenital talipes occurs almost always during infancy; yet it occurs, also, at every period of life; but, at a later period than the first few years of existence, its occurrence is comparatively rare.

PARALYSIS.

There are three divisions into which the subject of paralysis may be distributed, namely:

1st. That arising from organic change in the nervous centres.

2d. Myogenic, essential, infantile, or rheumatic paralysis.

3d. That arising from traumatic lesion of nerve-trunks.

1. *Structural Change.*—Paralysis from organic change in the nervous centres is common, both during infancy and in childhood, as well as in adult age. Hemiplegia and paraplegia result from apoplexy, cerebral and spinal, without lesion of vessels and effusion of blood—congestive apoplexy, or with effusion. When extravasation does occur in infants, it is fatal. Or, less extensive weakness may result; a limb or certain muscles only being affected.

In adults, hemiplegia with flaccid muscles, the muscles remaining loose and flabby, takes place. The muscles undergo atrophy, they degenerate, and the limb remains unused and useless. Or, from being in the first instance flaccid, the muscles become rigid: the wasted loose muscles become rigid and tense, and cause contractions of the limbs which they influence. The flexor muscles are most frequently thus affected.

Or, again, rigidity may exist, according to Dr. Todd, from the commencement of, or soon after, the attack.[1] In this class of cases, nutrition is not materially altered, and wasting does not proceed as in paralysis with flaccid muscles; but, should loss of power continue, wasting takes place. Atrophy is always induced by inaction, even without disease; and it takes place in all cases of contraction, from whatever cause, when it is persistent: and not only is this atrophy observed of those muscles which are extended, but also of those which are contracted.

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[1] 'Clinical Lectures on Paralysis,' 1854.

During infancy, paralysis frequently occurs without evident cerebral disturbance. Loss of power is occasioned of a limb, or of a group of muscles during sleep, or whilst a child is at play, without previous indication of the formidable result, and whilst it is apparently in its usual state of health. Florid, robust children are often the subjects of this form of paralysis, as well as the weak and puny.

Congestion and loss of power, or effusion and its consequences, are often traceable in children to over excitement, or to negligence and poverty.

Fractures of the skull may give rise to paralysis, either as an immediate consequence of lesion of the brain (or spinal cord when the vertebral canal is injured), or through consecutive inflammation of the meninges and brain substance.

I lately watched the following case, and cite it as an example to show the mode in which paralysis and distortion occur.

A child, three years of age, met with a severe contusion of the head and fracture of the skull from a blow: blood was effused beneath the scalp, which concealed the depressed bone, but having been absorbed, and the thickening, which had resulted having been removed, the fractured bone could be readily traced. No cerebral disturbance resulted immediately, consequent on the fracture, and the child had entirely recovered from the concussion when I saw it. Three days after the accident symptoms of inflammation ensued. The muscles of the face were spasmodically affected, and the thumb was flexed into the palm. Some few hours later, the hand was clenched and prone; and, on the following day, the forearm was flexed, the leg was flexed upon the thigh, and the thigh upon the trunk, and the extensors of the foot were in a state of clonic spasm. Hemiplegia succeeded. Finally, the spinal column became curved, the concavity being, of course, towards the paralysed side, and the flexor muscles of the leg and the extensors of the foot became permanently retracted. The fingers, also, were folded into the palm, the flexor muscles being retracted.

II. *Myogenic Paralysis.*—This form of paralysis occurs without appreciable nervous lesion, excepting atrophy of the anterior roots of the muscular nerves, which occurs probably subsequent to and is consequent on this paralytic muscular atrophy. This paralysis rarely occurs except during infancy, and is, therefore, termed, *essential paralysis of infants.*

According to MM. Rilliet and Barthez, two thirds of the children thus affected are under two years of age. As far as my experience will enable me to speak, I believe it to occur comparatively rarely earlier than the ninth month, or later than the eighteenth. It is probable that, as is suggested by Bouchut, its character is rheumatic, and, also, that it is occasioned by the too rapid cooling of the body. It is sudden in its access, and is induced by exposure to cold; such as draughts of cold air during the day, or the cold night air during sleep, on throwing off the bedclothes. It not unfrequently occurs during recovery from febrile and other debilitating diseases, when the child is particularly sensitive to the impression of cold. Often, the attack is preceded by more or less acute pain, which lasts two or three days; "the sensibility of the part is," then, in the words of Dr. Henry Kennedy, "wonderfully increased, and the child does not allow the limb to be touched." The subsidence of pain is accompanied by partial or complete loss of motor power in the affected muscles.

Associated muscles are affected in this form of paralysis, and the lower extremity more frequently than the upper.

This form of paralysis is very variable, both in extent, and degree, and in duration. A single muscle may suffer loss of power, or a group of muscles, or a limb, or the extremities of one side may be affected. Motor power may not be entirely lost, and sensation remains for the most part unaffected, or but little impaired. Power may be regained in the course of some few weeks, or months may pass before it is regained, or it may be only partially restored. It is rare that power is not in part restored to the paralysed limb, but this generally takes place within two or three years from the period of the attack.

In 1853, I saw a gentleman's child, who, at the age of eighteen months, on recovering from fever, suddenly lost in part the use of the extremities of the right side. The deltoid was entirely paralysed, as well as the extensors of the leg; and the muscles of the calf were in part paralysed. The child could drag itself along the floor very slowly, and its efforts caused considerable fatigue. This state had existed during three years, without alteration. By the use of baths, frictions, cod-liver oil, galvanism, and support to the weakened limbs, power was almost perfectly restored to the lower extremity; the deltoid, however, remained weak.

Contraction, in consequence of this form of paralysis, takes place slowly; and the child's health not being impaired, the attack may probably be overlooked until contraction has taken place.

III. *Solution of Continuity of the Nerve-trunk* is a rare occasion of paralysis. I had occasion to see, some months since, a severe form of calcaneus, which had been occasioned by the removal of a portion of the posterior tibial nerve together with a tumour from the back of the leg extending into the popliteal space. And in a similar manner, paralysis of the various groups of muscles, abductors, adductors, or flexors of the foot, and corresponding distortions, may be induced. This is necessarily a rare cause of distortion, and needs only passing allusion.

Paralysis is by far the most common cause of non-congenital talipes. Every form of talipes occurs from this cause, but those which most commonly arise are equinus and equino-varus.

Paralysis of M. tibialis anticus, extensores, longus et brevis, digitorum, and peroneus tertius occasions *talipes equinus*, through retraction of M. gastrocnemius, soleus, plantaris, and flexores, longus et brevis, digitorum.

Again, the reverse of this, or paralysis of the extensors of the foot occasions retraction of M. tibialis anticus, peroneus tertius, and the long and short extensors of the toes, or *talipes calcaneus*.

And paralysis of M. peronei, longus, brevis, et tertius, and extensores digitorum, longus et brevis, causes retraction of M. gastrocnemius, soleus, plantaris, tibiales, anticus et posticus, flexores digitorum, longus et brevis, flexor longus pollicis, extensor proprius pollicis, &c., or *talipes varus*.

And paralysis of the adductors of the foot, or of the adductors and flexors, occasions retraction of the peronei, or of the abductors and extensors of the foot, or *talipes valgus*.

It will be at once understood, however, that paralysis and distortion are found in every degree, and vary exceedingly; a single muscle, or several muscles, being paralysed, and this depending entirely on the nature and amount of the disturbing influence; but, when the balance of power is destroyed, by which antagonistic muscles are regulated, distortion inevitably succeeds.

Females appear to be more frequently affected with paralytic and other forms of non-congenital talipes than males. Duval gives the following numbers to show the relative frequency of non-congenital talipes in the two sexes, and also that the left foot is more frequently affected than the right.[1] Double non-congenital talipes is comparatively rare.

Non-Congenital Talipes.

Double	Males		9		14
	Females		5		
Single	Males	right foot	13	35	81
		left foot	22		
	Females	right foot	18	46	
		left foot	28		
Total					95

In all cases of non-congenital talipes, from whatever cause, the temperature of the limb is reduced below the standard of health; but this is especially the case with paralytic distortions. The free motion of the limb is rendered impossible, and the movements of the tibio-tarsal joint are at best greatly impaired. Heine records several observations showing the relative heat of several parts of the body, to contrast the temperature of the paralysed lower extremities with the heat of the trunk and mouth. The following is one of several, which do not essentially differ. The patient was a girl, eight years of age, who had suffered from convulsions at fifteen months. These attacks were immediately followed by paralysis of the lower extremities.

Heat of room	15°	Reaum. = 66° Fahr.
,, mouth	30°	,,
,, neck	29°	,,
,, back	28°	,,
,, loins	27°	,,

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[1] Op. cit., p. 328.

	LEFT.	RIGHT.
Heat of thigh . .	21° Reaum.	20° Reaum.
„ knee . .	19½° „	19° „
„ leg . .	14½° „	14° „
„ sole of foot	14° „	14° „ [1]

When both feet are affected, they are, not unfrequently, differently distorted; as, for instance, with equino-valgus of one foot, there may be equino-varus of the other.

When single muscles or groups of muscles are paralysed, it is in the following order of frequency; namely, 1st, extensor longus digitorum; 2d, tibialis anticus; 3d, extensor proprius pollicis pedis; 4th, the supinators of the wrist and the extensors of the fingers; 5th, deltoid; 6th, sterno-mastoid; 7th, the extensors of the leg.

The muscles of speech are sometimes paralysed, together with other muscles. I have lately seen as many as four cases in which this had occurred. In two of them the flexors of the foot, and the supinators and extensors of the hand and fingers, had also suffered loss of power.[2]

The diagnosis of myogenic paralysis is often difficult. If paralysis is more or less localized, and has been preceded by muscular pain; if it has appeared suddenly; if the secretions are not disordered, and the child has not been convulsed, the affection is of the muscles, simply, and without disease of the nervous centres. But if it has succeeded febrile action, occasioned by worms in the alimentary canal, by dentition, or other of the many causes already enumerated, incident to infancy, or dependent on other sources of irritation of the brain or spinal cord, it will have been induced by lesion of the nervous system.

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[1] 'Beobachtungen über Lähmungszustände der untern extremitäten und deren behandlung,' p. 16, Stuttgart, 1840.

[2] "Sir Benjamin Brodie lately mentioned to me," says Mr. Adams, "a case brought to him, in which the muscles of deglutition were paralysed in a child. The attempts to swallow were very painful to witness." (Lectures on Orthopædic Surgery, 'Med. Times and Gazette,' Dec. 1855.)

SPASM.

Spasm and paralysis sometimes coexist; spasm of one limb, paralysis of the other. Spasm may terminate in paralysis, and returning power is not unfrequently marked by spastic action; indeed, the primary cause of these conditions— spasm and paralysis—is, to a certain extent, identical.

Spasmodic action is usually first developed in the upper, and later in the lower extremities. Also, the upper extremities recover power before the lower. There are many exceptions, however, to both of these propositions. But in paralysis the reverse of this usually obtains, the arm being the last to recover power.

Some cerebral disturbance usually accompanies spasmodic muscular contractions; and this may be, and, in fact, is generally repeated, a succession of slight fits following—at various periods, perhaps several times in the course of twelve hours, or three or four times in the course of a twelvemonth—the first convulsive attack. After the first attack, the limbs may remain in a state of tonic spasm, and the muscles become rigid, and give rise to fearful distortions of the trunk and limbs.

The flexors of the limbs are the muscles which especially occasion distortion in these spasmodic affections, for they are generally more powerful than the extensors. As Dr. Mason Good says, "a very slight survey of the animal frame will show us that the flexor muscles have in every part some preponderance over the extensors;" and this is well exemplified in these diseases: for the thighs become flexed upon the trunk, and, through contraction of the powerful adductors, the knees are approximated, and crossed even, one over the other; and so rigidly are they thus maintained, that the application of considerable force may be wholly insufficient to separate the thighs: the legs are flexed upon the thighs, the feet are extended and inverted, and the toes frequently are flexed. The arms are bound to the sides by the combined actions of M. latissimus dorsi and pectoralis major; or the latter muscle alone acting, they may be crossed on the chest; the fore-arms are flexed, the hands are prone, and the fingers are flexed. The rectus oculi internus frequently is affected, producing convergent strabismus: very rarely, divergent strabismus is seen. Strabismus is always found on the same side as the rigid muscles, when one side alone is affected.

Spasm of the extremities of one side is more usual than more extensive irregular muscular action; or both lower extremities are affected, or a single limb, or a group or groups of muscles.

In spasm, the flexors and pronators usually distort the limb, but the extensors[1] and supinators are most commonly paralysed. Hence, in paralysis and spasm, a similarity of distortion prevails.

The spinal column, in the cervical and dorsal regions, is occasionally, at the same time as the extremities, distorted, by the irregular action of M. latissimus dorsi, trapezius, erector spinæ, sterno-cleido-mastoideus, &c., but this is not a common complication. The bladder and rectum are also occasionally implicated; the bladder is more frequently affected than the rectum, and its contents may be ejected with great violence, after having been retained during, perhaps, an inordinate time.[1]

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[1] The muscles of the calf of the leg were classed as flexors by Rudolphi, Walther, and others.

In severe forms of this affection, the countenance of the child is indicative of cerebral disturbance; the child is heavy and listless, and wears a vacant expression, and the intellect is usually somewhat torpid; but it may generally be roused to notice surrounding objects, and is more intelligent than might be supposed by a casual observer. Not unfrequently children thus affected are very excitable.

In a large number of instances, cerebral symptoms are not observable; the child has never been known to have a fit, nor shown any disposition to cerebral disturbance. Tonic muscular contractions have been induced, doubtless, by some hidden irritation, which may not sensibly affect the health of the child.

The following case will serve to illustrate a class of cases which is far from uncommon:

Towards the close of 1854, the child of a clergyman was brought to me, having double talipes equinus. She was four years of age, dark, florid, stout, and remarkably healthy in appearance. She had never had any infantile disease, nor a day's illness; the teeth were cut remarkable easily and without pain. The child was precocious, and more observant and inquisitive than I have ever before or since known.

Eighteen months before I saw her, she was observed to limp in walking, and this gradually increased until she stumbled; and at length, the heels were observed not to touch the ground, and the child fell after making a few paces, or when walking she steadied herself with a stick.

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[1] I have lately seen an instance of this in a child, three years of age, who had suffered from spastic contractions since the age of nine months. The bladder was seldom emptied oftener than once in twelve hours, and occasionally its contents were retained forty-eight hours, causing considerable suffering.

The extensor muscles of the right foot were more retracted than those of the left, and consequently the right heel was more elevated than the left; the pelvis had become slightly oblique, and the spine was curved with a single curve. There was no paralysis of the flexor muscles of the foot, and no other abnormal muscular action (that of the muscles of the back, consequent on the obliquity of the pelvis, to restore equilibrium, not being considered) than that of the extensors of the feet.

During the first three years of life, children are particularly subject to convulsive affections. Spasm is occasionally developed at birth or some few days after; it may be occasioned by pressure of the head of the fœtus in its passage through the pelvis;[1] it may also be induced by instrumental interference. When it occurs at birth, without undue pressure having been exercised, it takes place, for the most part, in those who are puny and ill-nourished, and who have not completed the full period of gestation. These are unusually predisposed to congestion and spasmodic affections, through the imperfection of the circulatory system and of the respiratory organs.

When the child has been convulsed, some muscular weakness may result, or the limb may be paralysed, or a state of spastic contraction of muscle may ensue. Not unfrequently, any of these conditions, affecting the lower limbs exclusively, remains unperceived until the child should commence to use its feet; or being observed, it is often thought to be unimportant, and gains less attention than it deserves.

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[1] *Vide* 'Observations on Cerebral and Spinal Apoplexy, Paralysis, and Convulsions,' by Evory Kennedy, M.D., in 'Dublin Journal of Medical Science,' vol. x, art. 27.

Rigidity of some of the muscles remains; such as the extensors of the feet, the pronators of the wrist, and the flexors of the fingers, the adductors of the thigh, &c.; or of any or all of them.

Frequently, convulsive action does not recur; generally, however, it is repeated, and becomes, but too frequently, a habit, so to say, which, after long continuance, may not be broken through on removal of the cause. Epilepsy is then developed, to the probable ultimate destruction of the mental faculties. The experience of Bicêtre, and other similar institutions, proves that every known distortion may follow in this train.

During infancy, spasmodic action is very frequently occasioned by dental and by intestinal irritation. These forms of irritation are common during infancy, and, at this period they constitute the prominent causes of spasm and of paralysis.

The great vascular excitement of the gums and alveolar processes during the period of dentition, and the pressure upon, and irritation of, the dental branches of the trifacial nerve pending the irruption of the teeth, frequently occasion cerebral excitement and spasmodic action. Gastro-intestinal irritation, induced by disordered secretions, is also a very fertile source of infantile convulsions. The fæcal evacuations become highly offensive, and are deficient in bile; scybala and large masses of ill-coloured, or white, secretions, together with, frequently, rolls of thread-worms in surprising numbers, are removed by purgative medicines and by injections.

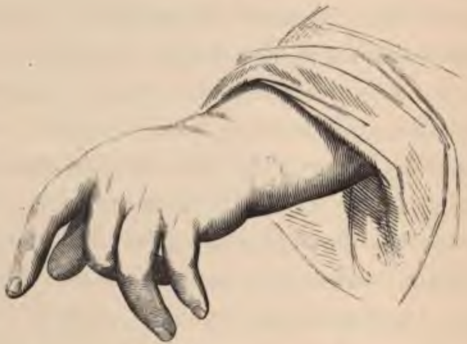
Many other causes of cerebral congestion and spasmodic action exist; as hooping-cough, smallpox, measles, scarlet fever, pneumonia, exposure to the sun's rays, a slight access of fever, a renal calculus, obstinate constipation, indigestion, a flesh wound, the irritation of an insufficiently strangulated nævus, &c.

Carpo-pedal spasm may exist without cerebral disturbance, but the persistence of irritation is generally followed by convulsions.

Cerebral symptoms are generally, and probably always, preceded by spastic contractions: these often pass unnoticed, and it is then only after convulsions have been developed that attention is directed to the source of irritation.

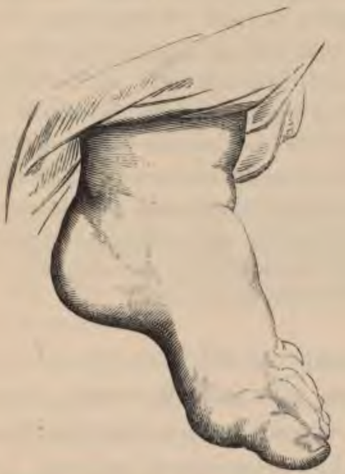
In this carpo-pedal spasm the thumb is drawn into the palm, the fingers are flexed, the feet are extended and the toes are flexed. These spastic contractions occasionally continue for weeks and months, without convulsions being developed. This is, however, rare. The accompanying drawings were taken from an instance of this kind. (See fig. 17 and 18.)

Fig. 17.



In this case, dentition had commenced at the third month. Two months later, the child was delicate and puny, and was suffering considerable pain; the gums were swollen and tense. In consequence of the inflamed, painful condition of the gums, the child often refused the breast; it was irritable and anæmic. When the child cried, being in pain, the feet were forcibly extended, and the thumb and fingers were flexed into the palm. The fingers remained at all times slightly flexed, and the feet were generally slightly extended; but when the child was free from pain, the feet regained their normal direction.

Fig. 18.



Rarely, the adductors and extensors of the foot are simultaneously spastically contracted, and the thumb flexed into the palm, in these infantile disorders, without convulsions. Two such cases have come under my care. In the first, the distortion had almost the appearance of congenital varus of the third degree. In the second instance, the feet were less inverted.

The following is, in few words, the history of the first case:

June, 1853.—E. S., æt. 18 months; blonde and pallid; was cutting the canine teeth; had been subject during some weeks to repeated diarrhœa; had lately lost flesh; lived four miles away from the metropolis. For two months the feet had been inverted; at first the toes only being turned in, but at length the anterior portion of the foot was fully inverted, and the outer edge of the foot alone was brought into contact with the ground. The child had, prior to this malposition of the feet, walked alone; but now, after some few steps, it was certain to fall. During sleep, the feet regained, in great measure, their normal direction, and distortion was not constant when the child was awake; but when standing, or if excited, the adductor muscles were powerfully contracted, inverting the foot. The tibial muscles, extensor proprius pollicis, gastrocnemius, soleus, and plantaris, were strongly contracted. The gums were painful and swollen, so I incised them; and with attention to the general health, allaying irritability, and promoting healthy secretions, this abnormal muscular action entirely subsided, and the feet regained and retained their normal direction.

Should the source of irritation not be removed, congestion and effusion will probably ensue, especially in those who may be predisposed by hereditary tendency; or rigidity may remain of the extremities of one side, or of both lower extremities, or certain muscles of a limb may alone remain affected.

The following is a case in point, and far from uncommon:

When fourteen months old, during dentition, was convulsed; and when he was two years old, had a second fit. From the date of the first fit, it was observed that his heels were raised, but only occasionally, and not continuously; so frequently, however, that he was often flung to the ground. After the second fit, this action was considerably increased. I first saw him fourteen months after the first attack. He was a dark, healthy-looking child, and rather plethoric. Both feet were equally affected, the heels being raised from the ground considerably, and the anterior part of the foot, which was slightly inverted, alone supported the trunk in progression. The M. gastrocnemii and tibiales antici were the only muscles affected.

In another somewhat similar case, also occurring during dentition, and after a slight fit,—

The Achilles tendons were very tense for nearly a twelvemonth, yet the heels could be planted on the ground; in six months more the heels were raised away from the ground, and the child moved about on the anterior portions of the feet only; but to enable him to oppose the heel to the ground, though very imperfectly, the knees were bent, and the trunk inclined forward. Notwithstanding this effort to increase the plant of the foot, and preserve equilibrium, the child fell at every trial to walk, or, more strictly speaking, in every twenty or thirty paces.

Spasmodic retraction is occasionally induced by emotional causes. Menorrhagia, amenorrhœa, dysmenorrhœa, hysteria, and chlorosis, are also occasionally accompanied by these forms of muscular contraction.

An instance is related by Andral of spasmodic contraction of the lower extremities, which was induced by fright and arrest of the menstrual secretion.

Retraction of the flexor muscles of the thigh and leg, so that the heels were brought into contact with the nates, occurred periodically; the periods being those at which the catamenia should have been present. This spasmodic retraction continued at these intervals, until the catamenia were re-established.

The following instance of muscular contraction with dysmenorrhœa lately came under my care:

It occurred in a florid, stout young person, seventeen years of age, in whom there was a tendency to cerebral congestion. At each catamenial period, the extensors and adductors of the right foot were so much contracted, as to bring the outer edge of the anterior portion of the foot alone to the ground, the inner surface being raised, and the heel fully an inch from the ground.

Onanism, with or without cerebral disturbance, may induce spastic contractions. These contractions are perhaps generally accompanied by muscular debility.

Cerebral congestion, in middle life, occasionally causes spastic contractions; it is then premonitory of further organic disease.

In parturition, pressure of the head of the fœtus, or subsequent inflammatory action, may occasion retraction of the ham-string muscles, and ultimately distortion of the foot. This muscular retraction has been thought to be occasioned by the improper use of the forceps. I am inclined to believe that it might often be prevented by their timely application.

I have lately seen two instances of this form of distortion.

The first case was a lady who had given birth to seven children in India, and who, on her husband's retirement from the military service, was confined of her eighth child in this country. In India, the forceps were used on each occasion; but on the birth of the eighth child they were thought to be unnecessary, and the period of labour was greatly prolonged. Whilst it was proceeding, very painful cramp was experienced in the affected limb. On the second day after parturition, pain had rather increased than diminished; but from this time it gradually abated, and ceased on the fifth or sixth day; the ham-string muscles remained contracted, and the toes only could be brought to rest on the ground.

The second instance occurred in a poor woman, who had previously given birth to two children. Inflammation of the iliac and crural veins commenced two days after parturition, and muscular retraction (of the ham-string muscles) succeeded about the tenth day, and increased until the foot was so much raised that the toes could not touch the ground.

It is scarcely necessary to state that, when the hands and feet are spasmodically affected, the acts of prehension and walking are rendered impossible.

In cases of severe spasmodic distortion, with cerebral disturbance, the prognosis must always be unfavorable, especially after puberty. Occasionally, severe cases, with a tolerably clear intellect, defy the powers of medicine. Some of these have their origin in abuses contracted in youth and continued in manhood; and it may be impossible to eradicate long continued habits of vicious indulgence, and, consequently, to remove spinal irritation, which has been set up.

But by far the largest number of these spasmodic cases, whether in the child or in the adult, are amenable to treatment: distortion may be entirely removed and will probably not recur. On removal of the cause spastic contractions cease: distortions can then be overcome, and the limb be subsequently retained in a normal position until its free use is obtained.

The influence of sleep on these patients is worthy of close observation. They are usually restless in sleep and disturbed; but in some instances, the contracted limbs are loosed, and the hands which were clenched will move freely, as an infant's in sleep. The muscles only wait, however, for the moment of waking to resume their rigidity. And the same may be occasionally witnessed in congenital distortions. I have noticed it in affections both of the hand and foot. Also the exhibition of chloroform is, in these cases, occasionally attended with similar results.

INFLAMMATION.

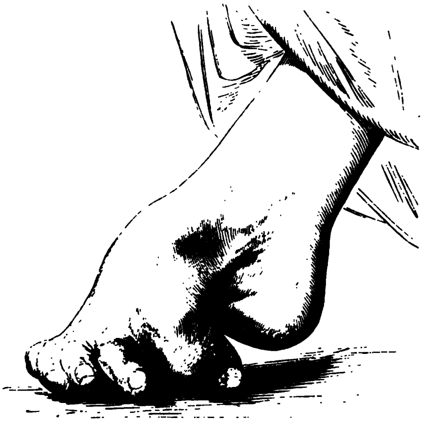
Inflammation of muscle occasionally gives rise to the distortions in question. Adhesion of the muscle to its sheath takes place; the free motions of the muscle are in consequence prevented; atrophy succeeds, and structural shortening; and distortion is proportioned to the previous inflammation.

A more common form of inflammation, and which gives rise more frequently to distortion, is of the skin and subcutaneous cellular tissue. A chilblain or an ulcer in healing may occasion adhesions to form between the muscle, or its sheath, and the superjacent skin: and these subsequently restrict motion, and occasion distortion. Perhaps, the muscles of the calf of the leg are more frequently affected than others in this manner. Scrofulous abscesses in the course of the muscles are also an occasional cause of distortion. Also, strumous deposits within muscles give rise to muscular retraction. I have observed them in the deltoid, in the biceps cubiti, in the rectus femoris, and in the calf of the leg.

Burns, also, are occasionally productive of talipes. I have lately seen two very severe forms which were induced by burns; one on the dorsum of the foot and anterior surface of the leg, occasioning calcaneus: the other, on the inner side of the foot and leg, had given rise to varus.

Traumatic inflammation may in like manner occasion distortions of a similar character. There is in the hospital at the present time, under the charge of Mr. Tamplin, a child with a very severe form of traumatic varus, which was

Fig. 19.



occasioned by a lacerated wound, caused by the wheel of a heavy waggon. (See fig. 19.) Incised and punctured wounds, also, and gun-shot wounds, are occasionally productive of these forms of distortion.

Rheumatic inflammation, especially of the structures in the sole of the foot, is a much more common cause of distortion than those last mentioned. The plantar fascia and ligaments frequently are attacked, and occasion great suffering.

Inflammation of muscle may terminate in exudation; the muscular fibre becomes pale red, or fawn coloured; induration results, and the transverse striæ are lost. The muscle is rendered immovable, atrophy results, and distortion is adapted to the amount of structural shortening.

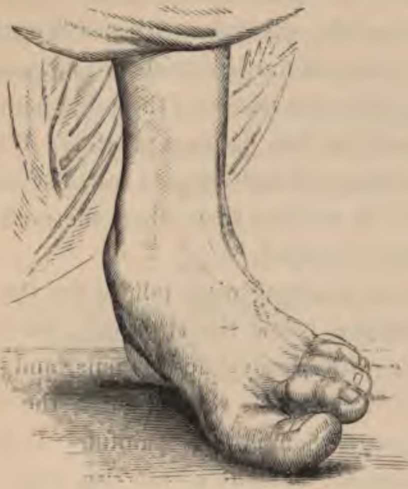
The ligamentous structures becoming inflamed are thickened and softened, and they lose their elasticity and peculiar lustre. Or, through repeated attacks of inflammation, they become indurated and thickened, and acquire a dense, firm, cartilaginous character; they become contracted, and impair the motions of the joint.

Inflammation of and about joints is a common cause of distortion. The knee-joint is perhaps more prone to be attacked than any other joint, if it be not the hip; but the ankle-joint is also frequently, similarly affected. The muscles contract to hold the joint at rest whilst it is in a painful condition; or they become contracted in consequence of a continued flexed, or extended position; and, subsequently, in consequence of structural change in the interior of the joint, the tension of tendons becomes permanent. Occasionally, both flexor and extensor tendons are found in this rigid, tense condition; more frequently, however, the extensors of the foot only. And, even when destruction of the joint is complete, or apparently so, tension of the tendons around may still continue. When muscular tension is present, mobility of the joint, as a rule, still exists. Yet, it is occasionally a nice point for the surgeon to determine, whether anchylosis is complete or partial. Voluntary motion may be apparently lost; and even an appreciable amount of motion, on making forcible attempts to move the joint, may be wanting, and yet the tendons passing over the joint may perhaps be rendered tense by these attempts at motion. Under such circumstances, the diagnosis will be favorable to partial anchylosis. This is not, however, an infallible argument whereon to base a strictly accurate diagnosis; and it may be necessary to have recourse to anæsthetic agents to determine between synostosis and anchylosis. When tendons are rendered tense by attempted motion, anæsthesia should always be obtained, before the case is pronounced hopeless through anchylosis.

VOLUNTARY POSITION.

Distortion may be occasioned by an assumed position to avoid pain. I have known, especially, equinus and valgus to have been thus occasioned. A corn on the heel, or on the ball of the little toe, will occasion the heel to be raised, or the outer edge of the foot. (See fig. 20.) In time, shortening of the muscles of the calf results, so that either the heel cannot be placed on the ground, or the foot cannot be flexed beyond a right angle; or the superincumbent weight being thrown entirely on to the inner side of the foot, the plantar ligaments yield, and the arch of the foot sinks. Thus, voluntary position occasions talipes with healthy muscles;* but it is a rare occasion of distortion.

Fig. 20.



DEBILITY.

Talipes valgus is very commonly caused by debility, and it is the only form of talipes that is thus occasioned. Extension of the plantar ligaments allows the arch of the foot to sink. Distortion commences with a sense of weakness beneath the arch of the foot. Nothing abnormal may be observed on raising the foot from the ground, but when the weight of the body is borne on the feet, the arch of the foot may appear to be destroyed, and the foot to be flat on the ground. It is a very common affection in delicate young persons; it seldom occurs before the age of twelve, or later than thirty. It not unfrequently exists together with rachitis. In a slight degree only and in the commencement of the affection, it is spoken of as "growing out" of the ankle; the inner malleolus projecting, through laxity of the deltoid ligament.

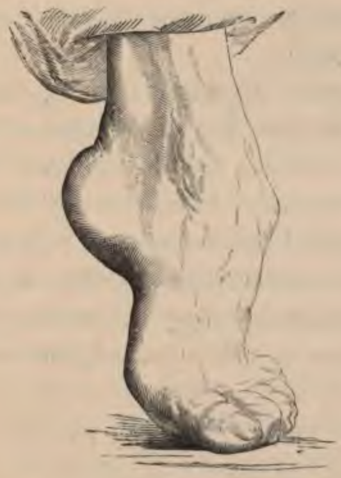
Waiters in taverns, errand boys, compositors, and those who are required to stand for many successive hours are very subject to this painful affection. Extension of the calcaneo-scaphoid and other plantar ligaments is induced, the plantar arch gradually sinks, the motion of the ankle-joint is impaired, and adduction of the foot becomes painful. When the arch of the foot is destroyed and the sole rests flat on the ground, less pain is felt in walking than when the arch of the foot is only partially destroyed.

In all cases of non-congenital talipes the temperature of the limb is reduced below the standard; but this is especially the case with paralytic distortions, and with valgus from debility. The foot is red or bluish, the circulation is languid, and progression is very painful. It is impossible to take an adequate amount of exercise with any form of talipes; for, even in congenital distortions, although the motions of the limbs may be rapid, yet the foot itself has little or no individual movement allowed to it, but remains more or less fixed, as the extremities are moved in walking. Hence, cold is ill borne, and the feet are much exposed to chilblains and troublesome forms of ulceration.

TALIPES EQUINUS.—Equinus is perhaps the commonest form of non-congenital talipes. It is essentially a non-congenital distortion, although, as has been shown, it occurs also as a congenital affection. The toes are pointed to the ground and the heel is raised, the muscles of the calf of the leg being retracted. It varies in degree from inability to flex the foot beyond a right angle, to a vertical position of the foot, the heads of the metatarsal bones and the phalanges supporting the superincumbent weight.

In an extreme degree of distortion the calcaneum assumes nearly a vertical position, and the astragalus is tilted forwards, so that the anterior portion of its superior articular surface remains uncovered by the tibia—thrust out of the tibio-tarsal articulation—and the head of the bone presents prominently beneath the skin on the dorsum of the foot. (See fig. 21.) In extreme cases of vertical equinus ulceration of the superjacent skin may be occasioned by pressure of the head of the astragalus. This is, however, exceedingly rare, and can only occur when distortion has become excessive, and the head of the astragalus inordinately prominent.

Fig. 21.

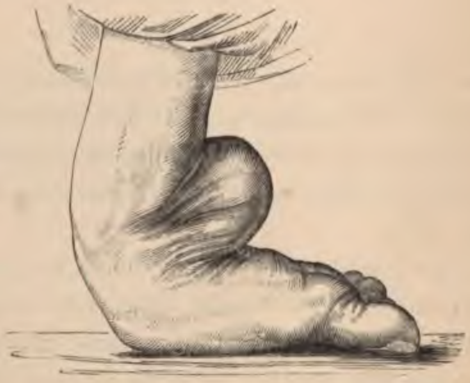


The metatarsal bones assume, more or less, a vertical position, and their extremities, bearing the superincumbent weight and transmitting it to the ground, become separated slightly one from another, so as to increase the breadth of the anterior portion of the foot. Even before this degree of distortion is reached, the longitudinal arch of the foot becomes contracted, its extremities being approximated, so that the concavity of the sole is increased, and the foot is shortened.

The ligamentous structures on the dorsum of the foot, especially the astragalo-scaphoid ligament, become elongated, and permit of considerable and abnormal motion of the scaphoid on the head of the astragalus; and the lateral tibio-tarsal ligaments are also elongated anteriorly, but contracted posteriorly.

With a moderate degree of equinus, the great toe is extended upon the foot; and in an extreme degree, all the toes may be in the same manner extended, their tips only resting on the ground. When the muscles on the front aspect of the leg and foot are affected with spasm, the toes are still further retracted, like the claws of the cat. But when the extensores, longus et brevis, digitorum are paralysed, the toes are not retracted, but are, on the con-

Fig. 22.



trary, flexed into the sole of the foot, so that the weight of the body is transmitted to the ground through their dorsal surfaces. And, when loss of power is general on the anterior surface of the leg, the foot becomes retroverted and the dorsum rests on the ground. (See fig. 22.)

But, instead of retroversion, slight action of the adductors will raise the inner border of the foot, and talipes varus will be induced; or, deviating to a less extent inwards or outwards, as the power of the adductors or the abductors preponderates, *equino-varus* or *equino-valgus* is produced, as the case may be.

The extensor muscles of the foot may be only slightly retracted, so that the heel may still rest on the ground, but not allow of flexion of the foot. Great inconvenience is thereby occasioned without absolute distortion. On account of the tense state of the tendo Achillis there is no motion at the ankle-joint in walking, and progression is, consequently laboured; and the knee-joint, as well as the ankle, is necessarily held motionless.

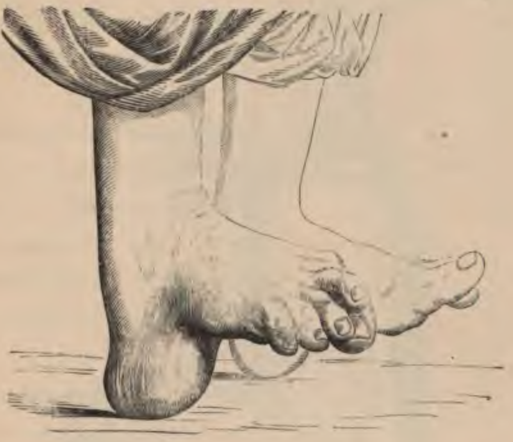
But a more common degree of retraction, and to which that first described in general quickly proceeds, is elevation of the heel, to the extent of one inch or thereabouts. Occasionally, three or four, or more years elapse before the heels are so much elevated that the child is taken off its feet. When retraction increases gradually and slowly, and both feet are affected, the child will flex the thighs on the trunk, and throw the trunk forward, that the heels may be brought to the ground in standing. It is curious to observe how much distortion is occasionally superinduced, by non-removal of talipes at its commencement.

The contracted muscles are, in the calf of the leg, gastrocnemius, soleus and plantaris, which cause elevation of the heel; and in the sole of the foot, flexor brevis digitorum, which is instrumental in causing the metatarsal bones to assume a vertical position: they likewise produce retroversion of the foot, and tend to contract the longitudinal arch. And together with retraction of the last-mentioned muscle the plantar fascia is always contracted. But, although these are the agents which chiefly produce talipes equinus, other structures on the dorsum and in the sole of the foot subsequently become implicated; those in the sole, muscles as well as ligaments, being contracted, while on the dorsum they are in the same ratio elongated.

Atrophy of the muscles of the calf of the leg commences before the most severe grade of distortion has been reached; the bulk of the muscle appears to be higher than usual on the leg, and the length of the tendo Achillis to be increased. In the most severe grade of distortion, very slight motion is permitted at the ankle-joint, in consequence of the position of the astragalus and the tense retraction of the extensor muscles. Thus, eventually, the purposes of the articulation are no longer fulfilled: the articular cartilages on the anterior and lateral surfaces of the astragalus, and on the superior portion of the head of the astragalus, become thin and irregular, or they are removed, exposing the osseous surfaces; whilst the synovial membranes are softened, the ligaments lose their elasticity, and the muscles undergo fatty degeneration.

TALIPES CALCANEUS.—Non-congenital calcaneus generally occurs as a paralytic affection: the heel drops, from paralysis of the muscles of the calf of the leg. The anterior portion of the foot is slightly raised from the ground, and the heel only is in contact with the ground. (See fig. 23).

Fig. 23.

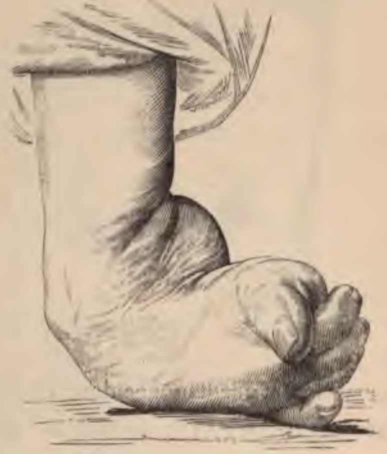


When, however, it is induced by accident or affection of the anterior muscles of the leg, the distortion simulates more closely the congenital distortion. M. extensor longus digitorum, extensor proprius pollicis, tibialis anticus, and peroneus tertius are retracted, slightly or forcibly, to raise the anterior portion of the foot and depress the heel; the tendo Achillis is tense, and the calf of the leg is less wasted than in the first-mentioned variety.

After some continuance of distortion, the lateral tibio-tarsal ligaments become extended; and the muscles in the sole of the foot, as well as the plantar fascia, become retracted, and tend still further to draw the heel downwards and forwards.

Talipes varus. — This, as every other form of non-congenital distortion, differs materially from congenital distortion, so that at a glance it may be asserted positively that the affection is not congenital. (See figs. 24 and 25.)

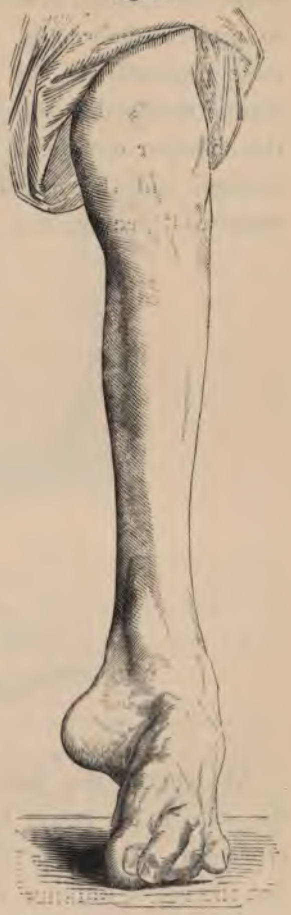
Fig. 24.



The foot is seldom as much inverted as in the third degree of congenital varus, and the distortion has not the same solid character as in the congenital affection, but the foot admits of more motion. For the most part, the dorsum of the fifth toe rests on the ground, the muscles in the sole of the foot are retracted, the heel is slightly raised, and the great toe is extended. The act of walking is both slow and painful, on account of the imperfect manner in which the foot is planted on the ground, and the consequent want of solid support; it is painful also because the callosity on the outer side of the foot is very imperfectly developed.

On the outer side of the foot and ankle the ligaments

Fig. 25.



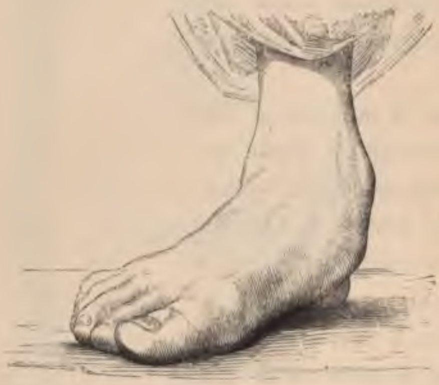
become considerably extended; and they are somewhat contracted on the inner side. The plantar fascia is generally, also, contracted.

In non-congenital distortions, and especially varus, the diminished vitality of the limb is favorable to inflammation and ulceration: troublesome sores are frequently found, and pressure is ill borne.

The adductor muscles of the foot are occasionally alone retracted; but generally the extensors of the foot are likewise affected. In the worst forms of non-congenital varus the foot is so turned round that the dorsal surface is in contact with the ground and the sole uppermost: this is, however, rare, and only takes place after long-continued use of the distorted limb.

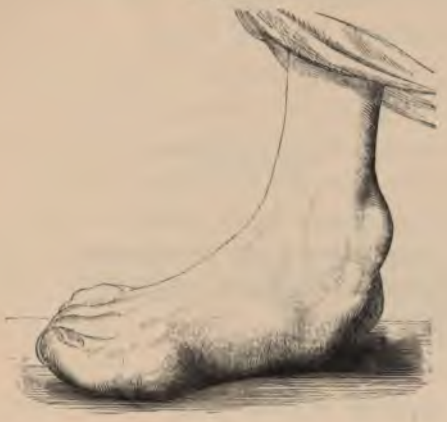
Talipes valgus.—This very painful and common affection commences with a sense of weakness beneath the arch of the foot, which is noticed especially in walking. In the commencement of the affection, when the foot is raised from the ground, no deviation from the normal condition may be observable in its shape, but when the weight of the body is borne on the foot, as in walking, the inner malleolus is seen to project abnormally, and to be in more than ordinary close proximity to the ground. Gradually and slowly the plantar arch sinks; the plantar ligaments become lengthened, the abductor muscles of the foot shortened, the foot slightly everted, and the motions of the ankle joint painful and impaired. (See fig. 26.)

Fig. 26.



At length, the arch of the foot is destroyed, and the sole, in its entire length, rests on the ground; pain is especially referred to the position of the scaphoid bone, but the act of walking is less painful than before the arch of the foot was destroyed. The foot itself is slightly lengthened, through destruction of its arch, the dorsum is flattened, the outer edge of the foot is slightly raised (see fig. 27); progression is effected slowly and with lameness, and with very slight motion at the tibio-tarsal joint. It is comparatively rare, however, that this affection proceeds to the extent now described; for the pain occasioned by extension of the plantar ligaments compels those afflicted with valgus to seek relief.

Fig. 27.



Valgus is generally occasioned by debility; less frequently it proceeds from inflammation of the structures in the sole of the foot and its consequences; and occasionally it is of spasmodic origin.

Thus, as their names imply, there are certain similarities of appearance between congenital and non-congenital talipes, though the distinctions are so marked that the two can never be confounded. In the spasmodic forms of distortion, however, the difference between congenital and non-congenital distortions is occasionally less well marked than when distortion arises from other causes.

Complex varieties occur, also, as non-congenital affections; they are, however of rare occurrence, with the exception of equino-varus, to which attention has been above directed.

CHAPTER V.

STRUCTURAL PATHOLOGY AND PHYSIOLOGY IN RELATION TO STRUCTURAL SHORTENING OF MUSCLES AND RE-UNION OF TENDONS.

When muscles remain long inactive they waste;—ultimately fatty degeneration ensues, and the muscular tissue is in part or wholly lost. Any cause having a tendency to destroy, and destroying mobility, occasions this result. Thus, *in utero*, the muscles which occasion talipes varus destroy the natural movements of the foot, by their tension, and by the rotation they induce of the tarsal bones on their axes. The contracted muscles become more or less immoveable, and when spasm has ceased to exist, they remain still shortened, in consequence of the changed positions of the bones, and by reason of their own contractility. Their antagonists, also, from want of power to overcome the retracted muscles, remain extended.

But, although the contracted muscles are shortened, their extremities being approximated, they have not at birth undergone structural shortening; nor, indeed, does structural shortening occur, until inaction, or some other abnormal condition, has destroyed the power of the muscle: or if structural shortening is ever found at birth, it is so rare as to prove the rule. That structural shortening has not taken place at birth is proved by the restoration of the shape of the foot through mechanical means alone. And further, it is proved by the unaided restoration of the limb on cessation of spasmodic action, when the bones do not interfere to prevent the antagonistic action of the muscles, as is witnessed in talipes calcaneus, and in club-hand. In these congenital affections, as spasm ceases to affect one set of muscles, their opponents resume their power and restore the normal shape of the limb.

By structural shortening of muscle is understood permanent approximation of its extremities without power of elongation. Atrophy, or structural change induced by inflammation or other cause, always precedes structural shortening.

It is pretended by some that the contracted muscles are, in their development, too short for the normal position of the foot. Others assert that shortening of the muscle is subsequent to the production of distortion, and commences simultaneously with, or immediately after, distortion. But both of these hypotheses are disproved by the restoration of the limb to its normal position by traction, or by the natural antagonistic force of the muscles themselves.

Atrophy soon follows on inaction, and also degeneration. It is found to occur even in the fœtus: but, whether in the fœtus or after birth, the extended muscles are first affected, and later the contracted muscles. In an instance recorded by my colleague, Mr. W. Adams, this fact is well illustrated. The child lived only some few hours after birth. The distortion (talipes varus) was of the most severe form. Fatty degeneration was so far advanced, that—

> "The extensor longus digitorum and peroneus tertius might almost be said to be absent, as far as their muscular fibres were concerned; their tendons existed, but were of very small size, and connected above with an extremely attenuated layer of muscular fibres, representing the extensor muscle; the muscular fasciculi were intermixed with fat dipping between them, so that their dissection could only be conducted to a very limited extent, and it was impossible to trace them to any connection with, or origin from, the bones or interosseous ligaments. The space between the outer border of the tibialis anticus and the fibula, which should be occupied by the fleshy belly of the extensor longus digitorum, was entirely filled with fat, in which no muscular fibres were traceable even with the microscope; the existence of the rudimental portion of this muscle, above described, was only demonstrated by the most careful dissection from below upwards, beginning from the tendons on the dorsum of the foot." . . . "Dr. Quain considered both the general and microscopical appearances to indicate a state of arrested development of the muscle, and subsequent decay and degeneration."[1]

But in the case now cited, in which the extended muscles had undergone such extensive degeneration—

> "The tibiales (anticus and posticus) muscles were fully developed, if not somewhat hypertrophied, and their tendons extremely tense."[2]

After birth, it is remarkable how rapidly structural change is occasionally effected in muscle. In the course of a few weeks (a fortnight, says Mr. Paget), the colour of the muscle may have undergone considerable change. But, when structural change is occasioned by inaction, years may elapse before it is induced. The muscle, when this change occurs, becomes pale, stained with yellowish or fawn-coloured patches, which coalesce, and the entire muscle perhaps assumes an uniform fawn colour; the transverse striæ disappear, the fibres become disintegrated, and are at last totally lost. The muscles are then transformed into yellowish or whitish fat, their forms are no longer traceable, but they coalesce into a mass not bearing a trace, perhaps, of the distinctive characters of muscle. The skin then loses its softness and elasticity, the nerves become atrophied, the ligaments are softened, and the bones even degenerate with the rest of the limb. In some rare instances these changes are met with to a very remarkable extent. A short time since, Mr. Quekett exhibited, at his Lectures at the College of Surgeons, an instance of distortion of the foot, in which no muscular fibre was to be found in the leg, so complete was the fatty change that had been induced.

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[1] 'Transactions of the Pathological Society,' p. 456, vol. iii.

[2] Op. cit., p. 455.

In a paralysed limb, the nerves passing to the affected muscles are always atrophied after some duration of paralysis; and the spinal cord, corresponding to the paralytic lesion, undergoes atrophy; it may be a lateral portion, or it may be the entire substance of the lower portion of the cord; it shrinks, becomes hard, and acquires a deeper hue. The bones become light, and their walls thin; the cancelli are increased in size, and are filled with oily matter.

When paralysis of the flexors of the foot, for instance, occurs, so that the foot dangles loosely, and the anterior portion of the foot drops, the limb is rendered comparatively useless until retraction of the extensors of the foot takes place; then, the limb is, so to say, *braced up*, and talipes equinus is produced. By this provision a certain amount of power is restored to the limb, and it again becomes a more useful member. Retraction increases (in proportion to the amount of paralysis), until the heel is uplifted, and the anterior portion of the foot is alone in contact with the ground.

Atrophy commences with the flexors of the foot; and when the heel is fully elevated, the muscles of the calf of the leg also undergo atrophy; the belly of the muscles appears to be higher on the leg than usual, and the length of the tendon to be increased. At length, the tibio-tarsal joint becomes fixed, motion is lost, structural shortening ensues, and, ultimately, fatty degeneration.

In general, structural shortening results only after motion is destroyed; and fatty degeneration is only found, complete at least, when the use of the limb is entirely lost.

Thus, structural shortening is not a usual accompaniment of the early stages of distortion, but is preceded by atrophy and inaction of the muscle.

The following aphorisms will be further discussed.

1st. On cessation of spasm, and on removal of the power of contraction by section of its tendon, the muscle relaxes; the normal length of the muscle being restored, increased length of its tendon is not required, but this being obtained, it weakens the muscle.

2d. When structural shortening has taken place, the muscle does not admit of elongation: but elongation of its tendon is necessary to restore the shape of the limb.

If the tendons of the retracted muscles in a child with congenital varus be divided, and allowed to reunite, and the limb be gradually reduced to its normal direction, it is found, when extension has been made gradually and carefully, that the new bond of union slowly contracts, so as to leave no outward mark on the tendon itself of the incision which had been made. On dividing the tendon longitudinally, a slight depression may be observed in its centre, corresponding to the section which was made; but this is also in time removed, so that, in fact, no mark is left of the section and reunion of the tendon.

This I have verified, both in the infant and in animals. In the latter, in the course of three months, it is not possible with precision to affirm which of two Achilles tendons has been divided. When, however, blood has been effused, or inflammation excited, a longer time is required entirely to obliterate the cicatrix and the central depression.

Numerous experiments have been made on the tendons of animals, to determine the mode of reunion after division, by Ammon, Mayo, Bouvier, Duval, Mr. Paget, Pirogoff, Thierfelder, Gerstaecker, Boner, Mr. W. Adams, myself, and some others.

It is contended by some, as *Boner*, that blood is poured out between the divided ends of the tendon, which, becoming organized, forms the new uniting medium. Boner affirms this to have been the case in thirty instances in which he experimented. But he contends that, should blood not be effused, the sheath falls together, and uniting with the ends of the tendon, they together form a solid cord. For the most part, however, according to Boner, the sheath becomes filled with blood, and the coagulum becomes organized by the end of the second week, to form the uniting bond between the divided ends of the tendon; which bond acquires its entire solidity by the fourth week.

Rabbits were chosen for these experiments, and the sections were made subcutaneously.[1]

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[1] *Vide* 'Die Regeneration der Sehnen,' in 'Archiv für Pathologische Anatomie und Physiologie,' von R. Virchow, p. 162, band vii, Berlin, 1854.

Pirogoff describes two modes of dividing tendons. In the *first*, the section is made from before backwards, the knife being introduced between the bone and the tendon, when effusion of blood into the sheath of the tendon always follows. In the *second*, the knife is introduced between the skin and the tendon, and the tendon divided from behind forwards; when this is carefully accomplished, blood is not effused into the sheath.

The following are the conclusions which Pirogoff draws from his experiments:

> "1st. There are two modes of reunion of tendons, which differ essentially one from the other.
>
> "2d. In the first, a new bond of union is formed; in the second, isolated cicatrization of the ends of the divided tendon takes place.
>
> "3d. Extravasation of blood within the sheath of the tendon is essential to the formation of a new intermediate bond of connection.
>
> "4th. The effused blood not only excites such an amount of irritation in the neighbouring tissues as is necessary for the formation of lymph, but it becomes itself an agent for the formation of plastic lymph.
>
> "5th. This metamorphosis of the effused blood may be divided into several distinct periods.
>
> "6th. The new connecting bond does not become tendinous, but, notwithstanding, it forms a perfect substitute for tendon.
>
> "7th. The functions of the limb are entirely restored after the first mode of division of the tendon has been adopted; but with the second it is impossible for the individual to extend the foot.
>
> "8th. Both the sheath and the ends of the tendon are instrumental in forming the reparative material; but it is the sheath which especially conduces to this end.
>
> "9th. In the second mode of reunion, the connecting bond lengthens as flexion of the foot is increased; but in the first mode, when fully formed, the bond always remains of the same length."[1]

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[1] 'Ueber die Durchschneiduug der Achillessehne als Operativ-orthopädisches Heilmittel,' Dorpat, 1840.

Pirogoff performed seventy subcutaneous sections of tendons on dogs, sheep, calves, and foals; and watched the results from twenty-four hours after the operation until a twelvemonth and more had expired.

Bouvier states that the effused blood has no influence in the production of reunion, but that the sheath of the tendon is principally concerned in this reparative action; and that the lymph which is thrown out from the divided extremities of the tendon is not instrumental to this end.[1]

In one instance, only, did Bouvier find blood effused into the sheath of the tendon; whereas Pirogoff found it in fifty instances, and he holds it to be the rule. Pirogoff alludes to this difference in their observations, and remarks, that it is very difficult to experiment and observe correctly.

Duval says:

> "The fibro-cellular sheath, which embraces the extremities of the divided tendon, and the blood effused within it, are the agents principally concerned in the reproduction of the intermediate substance; for it is impossible that this new material should be the result, as some persons think, of exudation from the extremities of the divided tendon, as they are found free and knobbed (mamelonnés), after many months.
>
> "The theory of the restoration of continuity of divided tendons may, after what has been said, be summed up as follows. A tendon being divided within its sheath, its divided ends retract, leaving a space, into which blood is poured, which blood becomes organized as well as the plastic lymph. The lymph is formed by the sheath, and is due to inflammation or congestion: the membrane having become thickened, its walls throw out an abundant exudation, composed of various materials necessary for reparative action, but the ends of the tendon do not share in this action in the slightest degree."[2]

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[1] 'Bulletin de l'Académie de Médecine,' Décembre, 1836.

[2] Op. cit., p. 326, Paris, 1843.

Mr. Paget experimented on rabbits; and I shall take the liberty of quoting at length his excellent description of the reunion of tendons; it is most lucid and accurate. He says:

"Very little blood is effused in the subcutaneous operations. Commonly, only a few blotches of extravasation appear in and near the space from which the upper part of the tendon is retracted. The first apparent consequence of the division of the tendon is the effusion of a fluid or a semi-fluid substance, which, like the product of common inflammation, quickly organizes itself into the well-known forms of lymph- or exudation-cells. The exuded lymph makes the tissues at and near the wound succulent and yellow, like parts infiltrated in anasarca. The blood-vessels near the divided tendon enlarge, as in an inflamed part, and appear filled with blood. The exudation, together with the enlargement of the vessels, swells the parts, so that the skin is scarcely at all depressed between the separated ends of the tendon. But in well-made subcutaneous sections, this inflammatory product is of small amount, and takes, I believe, little or no share in the healing of the injury; for the exudation ceases after the first twenty-four hours, and I think that its cells are not developed beyond the state in which they appear spindle-shaped. I have never seen indications of their forming filaments of cellular or fibrous tissue."

The reparative material "appears after three days as a soft, moist, and greyish substance, with a slight ruddy tinge, accidentally more or less blotched with blood, extending from one end of the tendon to the other, having no well-marked boundary, and merging gradually into the surrounding parts. In its gradual progress the reparative material becomes commensurately firmer, tougher, and greyer, the ruddiness successively disappearing from the circumference to the axis: it becomes, also, more defined from the surrounding parts, and, after four or five days, forms a distinct cord-like vascular bond of connection between the ends of the tendon, extending through all the space from which they have been retracted, and for a short distance ensheathing them both.

"As the bond of connection thus acquires toughness and definition, so the tissue around it loses its infiltrated and vascular appearance;

the blood-vessels regain their normal size, the inflammatory effusion clears up, and the integuments become looser, and slide more easily.

"With the increase of toughness, the new substance acquires a more decidedly filamentous appearance and structure. After the fourth day, the microscope detects nuclei in the previously homogeneous, fibrine-like reparative material; and after the seventh or eighth day, there appear well-marked filaments, like those of the less perfect forms of fibrous tissue. Gradually perfecting itself, but with a rate of progress which becomes gradually less, the new tissue may become at last, in all appearance, identical with that of the original tendon."[1]

In the experiments which I made to determine some points of Mr. Paget's description on which doubt had been cast, I endeavoured to divide the tendons in the same manner as in man, and afterwards to keep the limb at rest, and the articulation motionless; for it appeared to me, that to divide the tendons of animals, allowing the animal subsequently to move the limb at will, and to draw conclusions from the results obtained, and compare them with what occurs in man, when the limb is kept at perfect rest by means of splints and bandages until reunion is effected, would be to deceive one's self.

I found, on dividing the tendo Achillis in a rabbit, that the ends of the tendon were immediately separated to the distance of one inch; that is to say, that the upper extremity was drawn away by the muscles retracting to that extent. On the second day, a small and unimportant film of blood was found in the sheath of the tendon, and a small quantity of lymph was attached to the upper end of the tendon. On the third day, the space between the ends of the tendon was three fourths of an inch, the sheath was thickened and its vessels injected; soft lymph was attached to both extremities of the tendon, especially to the upper; and on the fourth day this constituted a soft bond of union. On the sixth day, the ends of the tendon were half an inch apart, and the intermediate space was filled by a firm, well-defined substance, streaked with blood, and distinctly fibrous. The ends of the tendon, especially the upper, were enveloped by this new material, to the extent of a quarter of an inch; they were also somewhat swollen, softened, and succulent. In some few instances an elongated clot of blood was embedded in the new material, apparently as an accidental product: it did not appreciably hinder the healing process. The new substance was well defined, and had already acquired considerable strength. On the seventh day, Mr. Paget found, in his experiments, that the half section of the connecting band would bear gradually increased suspended weights to the amount of ten pounds. On the eleventh day, the intermediate substance had contracted to a quarter of an inch in length, and was only slightly adherent to the cellular sheath; it was softer, paler, and thicker than the normal tendon, but not less well defined. It was capable of very considerable resistance. Mr. Paget found that, at this time, the half section was capable of bearing suspended weights to the amount of fifty pounds: it was broken with fifty-six pounds.

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[1] 'Lectures on Surgical Pathology,' p. 270, vol. i, 1853.

Occasionally, the tendon is streaked with blood, as is seen on making a longitudinal section. The reparative process apparently proceeds equally well, whether the sheath be entirely or in part only divided, yet the sheath is doubtless important in giving definition to the new product. In the above-mentioned experiments slight adhesion to the sheath generally existed; but in many instances the tendon was perfectly free in its sheath. When it was entirely divided, the sheath did not contract with the muscle.

Each day added to the strength and perfection of the intermediate substance: also, its length gradually diminished, until a slight bulbous enlargement of the tendon alone marked the point of division. At the end of the tenth week, or from that time to the third month, this enlargement had disappeared, and the point of union was only appreciable on making a longitudinal section of the tendon: a very small cupped depression marked the point of division of the tendon.

These examinations were continued from day to day for three months, and they tend to confirm the opinion entertained by Mr. Tamplin and others, of the gradual contraction of the new uniting bond, until a cicatrix alone remains; which, also, is subsequently removed, and is not to be traced even by microscopic aid.[1]

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[1] Whilst these pages are passing through the press, I perceive a paper by Mr. W. Adams ('Med. Times and Gazette,') on the subject of the division of tendons. Mr. Adams differs from former experimenters, and states that the space between the divided extremities of the tendon increases from one to two and a half inches. Now this is entirely at variance with what is known to occur both in man and animals, when the limb is kept at rest, and in a position to favour reunion. But in the experiments undertaken by Mr. Adams, and for which rabbits were chosen, after division of the tendon, the animal was allowed to move about, without any protection to prevent motion of the limb. Union was effected, but the uniting medium was stretched and rendered weak. Also in man the same occurs, when extension of the soft material is effected too rapidly. Not unfrequently, in animals, re-union does not take place, if the ends of the tendon are not in some measure approximated; but the ends of the tendon are gradually more widely separated until the intervening space may be several inches in length, the lower portion of the limb being drawn downwards by the action of the antagonistic muscles. I have known this to occur in a dog: the intervening space became half a foot in length.

That the uniting medium may be drawn out even to a greater extent than two and a half inches, is well understood; and in orthopædic surgery this is a most important circumstance, allowing as it does of the restoration of a limb to its

When the muscle has undergone structural shortening, so that division of its tendon cannot produce the desired relaxation or lengthening of the muscle itself, the new bond of connection may be extended to supply the deficiency occasioned by the abnormal condition of the muscle. It may be drawn out by gradual extension to the length of three inches, and upwards, beyond its normal length. This is a point of great importance in the treatment of old distortions, and those occasioned by injury and inflammation of muscle. When, however, extension to a similar extent is made, the muscles being healthy, the result is to occasion such an amount of debility as to render the limb comparatively useless. For instance, if the Achilles tendon be divided, the muscle being healthy, as is usual in infantile congenital varus, the muscle becomes relaxed, in consequence of the section; not immediately, however, but gradually and permanently, until solid reunion has taken place. But, if the new material is at the same time rapidly elongated to the length of three inches, debility, amounting to paralysis, is induced; and instead of equinus, a condition resembling calcaneus, or indeed calcaneus, will result.

Thus, I have endeavoured to show, that two distinct classes of cases exist requiring the division of tendons; namely, that in which the muscle is healthy but retracted; and secondly, that in which it has undergone structural change.

normal position after structural change in the muscles has taken place, and after the formation of adhesions. I make these remarks with regard to the experiments instituted by my friend and colleague, Mr. Adams, for it appears to me that they were not made with his usual acuteness of observation, and are calculated to mislead those who are less versed in the subject than himself.

CHAPTER VI.

TREATMENT.

THE treatment of talipes resolves itself into; *first,* the removal of distortion and restoration to the normal position of the limb; and, *secondly,* the restoration of function.

Removal of distortion may be effected by mechanical means alone; or by surgical and mechanical means combined. The former mode of treatment yields with advantage to the latter; yet, in a large number of cases undoubted success attends the employment of long-continued mechanical means.

Formerly, the most exaggerated notions prevailed, and the greatest dread was expressed, respecting the division of tendons. Thus, it was thought worthy of record, by Desport, that a patient in the Hôtel Dieu, in Paris, in whom the tendo Achillis had been divided, had recovered without amputation of the leg. And so late as the year 1835, we find Dr. Ryan thus expressing himself:

> "Some have supposed that the deformity (pes equinus) was caused by a rigidity and shortening of the extensor muscles; to remedy which, Delpech proposed to incise the tendo Achillis. It appears to me," continues Dr. Ryan, "that this operation would only be justifiable when all other means had failed; and even then I very much doubt its propriety."[1]

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[1] Lectures on the Physical Education and Diseases of Children, 'London Medical and Surgical Journal,' p. 234, vol. vii.

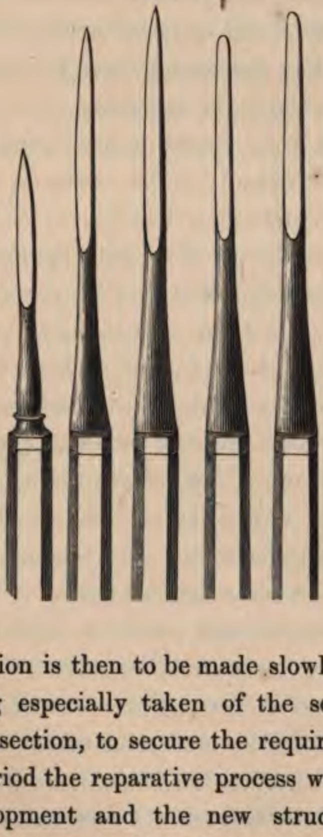
But, thanks to Delpech, Stromeyer, and their followers, few now can doubt the propriety and expediency of division of tendons for the removal of distortions. Subcutaneous section has rendered tenotomy harmless, and has removed the greatest difficulties which were formerly interposed in the treatment of these affections. Inflammation is, virtually, unknown; and the fear of it and its consequences need never deter the surgeon from operating the division of tendons. Certain precautions, however, are necessary to be observed which will now be discussed.

First. The division of a tendon should be effected with a clean cut; and the knife should be a fine blade and well tempered. For my own part, I prefer blades seven eighths of an inch in length, one inch, and one inch and one eighth, for general use in tenotomy, to those of half an inch, and five eighths of an inch, which are used by some, and with which, by dint of pressure, the tendon is eventually haggled in two. A straight blade, or one nearly straight, is more convenient than other shapes; although it is certain that the operator may accustom himself to any form which he may adopt. The width of the blade is however more important than its length or its shape: greater width than one eighth of an inch is never required; this affords sufficient material for strength, and more is unnecessary. (See fig. 28.)

Secondly. In dividing a tendon, freedom of motion should not be permitted to the knife; but the point should be held close to, and made to sweep half round, the tendon. Without attention to this point hemorrhage will follow the section (a small vein or occasionally a larger vessel being divided), which it is the object of the surgeon to avoid. Division of the tendo Achillis, the tendons of the tibial muscles, the hamstring tendons &c., is frequently, and should always be, perfectly bloodless. This cannot, however, invaribly be attained, but, as has been shown, effusion of blood within the sheath interferes with the process of re-union, and consequently even slight hemorrhage should if possible be avoided.

Thirdly. After division of the tendon the limb is to be retained in its abnormal position until re-union has commenced; extension is then to be made slowly and gradually, advantage being especially taken of the second and third weeks after the section, to secure the required elongation.

Fig. 28.



After this period the reparative process will have attained so much development and the new structure be so far organized, that extension will be imperfectly accomplished.

when contracted, is to be divided in its entire extent; and also that the muscles in the sole of the foot may have to be divided down to the metatarsal bones. The plantar fascia frequently requires to be divided in its entire breadth; but much more frequently a band only of the fascia being divided (and for the most part it is the inner and lateral portion of fascia which is contracted), extension may be effected equally well as though the fascia had been more freely incised. I have never yet seen a case in which it was necessary to divide the muscles as described by Phillips, and am inclined to doubt the necessity of the operation, and to question its propriety.

There are certain accidents to be guarded against, which occurring, would militate considerably against the success of tenotomy; such as division of the skin covering the tendon. This I have once known to have been done intentionally: suppuration followed, and a much more obstinate form of distortion resulted than the operation was undertaken to remove. And twice I have seen it occur accidentally. When adhesions exist between the skin and the sheath of the tendon, more than ordinary care is required in the division of the tendon; and also, when there is powerful spastic action of the opposed muscles, not only forcible flexion should not be made, but flexion should even be restrained.

After-treatment.—The operation completed, the patient should remain on the sofa, with the knee slightly bent, during the remainder of the day; and to avoid accidents, it is safer to enforce rest, until Scarpa's shoe is applied. The natural heat of the limb requires to be preserved by suitable warm covering.

On the fourth or fifth day after the operation, Scarpa's shoe may be applied. The bandage and lint are first to be removed, and the bandage to be re-applied. In this, as in every other distortion, the instrument for extension is to be fitted to the limb at the angle, whatever it may be, of distortion; and from that point extension will be made gradually.

Extension being made slowly, is to be increased gradually, until the heel is sufficiently depressed, and the foot flexed beyond a right angle with the leg. When the muscles are healthy, and especially in children, the required length of tendon should be gained before the expiration of the third week ; in adults, from three to four weeks will be required; and in paralytic limbs, longer time is necessary, organization being slower than in the former. But in every case, extension, whether slow or rapid, should be made equably, that every part of the tendon may be of equal strength. At the expiration of a month or six weeks, the process will be complete, and the foot may again be brought into use, the patient being furnished with a support attached to the shoe having a stop-joint corresponding to the ankle, to prevent extension of the foot beyond a right angle with the leg.

The distortions of the toes which, more or less, generally accompany talipes equinus, rarely require a special operation for their removal. Division of the tendo Achillis, and restoration to the normal position of the foot is usually sufficient to remove any abnormal extension or flexion of the toes. In long-standing distortion, however, the flexor or the extensor tendons may require to be divided.

Talipes varus.—This is the most complex distortion of the foot which the surgeon has to treat; it requires the division of several tendons, such as tibialis anticus, tibialis posticus, flexor longus digitorum, tendo Achillis, and frequently, also, the plantar fascia. These are the structures which ordinarily require division before the distortion can be reduced.

In the most simple form of varus, however, the tibialis anticus tendon alone requires to be divided; or, together with it, the plantar fascia.

In the treatment of distortions it has been laid down as a law, by an Edinburgh authority, that whatever structures are tense must be divided. This statement demands considerable qualification; its implicit observance would lead to fatal mistakes. For instance, in division of the hamstrings, if the knife be not limited to section of the tendons, but is permitted to divide all the structures that are tense, the peroneal nerve will necessarily be incised, together with the fascia and tendons. And it is both unnecessary and hazardous to follow the precept of Phillips, to divide the retracted muscles in the sole of the foot, as well as the plantar fascia. In cases of old varus, it is of much importance to distinguish between the structures which it is necessary to divide, and those which may be extended mechanically; for if, following the advice above referred to, all the tense and shortened structures were to be divided, nothing would be left in the sole of the foot, and on the inner side of the foot and leg undivided, but the bones. It is therefore important to determine which are the structures which it is imperative to divide, and to recognise the extensibility of the others.

In infancy cases frequently occur, which may be treated mechanically, and without division of tendons. Distortions so treated, however, require to be long under observation: they are necessarily tedious, and more pain is excited than when extension is made after division of the several tendons. Besides, the ultimate results of mechanical treatment are seldom, perhaps never, so favorable as when extension is made after tenotomy.

Phillips says, in reference to this point—

> "In the first degree of varus in infants, the foot may be restored without the division of tendons, and with the use of apparatus alone; but this treatment is long and difficult of execution, often painful, and rarely efficacious. It is better in every case, even the most simple, to divide the tendons."[1]

It must be fully understood that division of tendons is only in the strictest sense useful to facilitate mechanical treatment. Of itself, especially in adult varus, tenotomy accomplishes nothing towards the immediate reduction of distortion.

There are few cases in orthopædic practice in which extension alone is to be preferred to tenotomy.

The question of age at which division of the tendons in congenital varus is to be preferred, often occurs. Some think that the child should be able to walk before the tendons are divided; as Mr. Lizars, who says:

> "The child should be old enough to walk, seeing that the due exercise of the muscles, ligaments, and articulations of the foot is indispensable for recovery. Without this, the operation must prove abortive. Two or three years of age is the earliest time at which the division should be attempted. I prefer three years," continues Mr. Lizars, "because the apparatus previous to that period, however

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[1] Op. cit., p. 79.

carefully applied, often frets the skin, and the cure is retarded from the unwillingness of the child to put its foot to the ground."[1]

Dr. Little, in his work, says:

> "The most favorable period for the division of tendons, in infantile cases of talipes, is a few months before the time when the child may be expected to make the first attempts to walk—about the age of six or eight months, until which time, in cases of talipes varus, mechanical apparatus should be used to turn the toes outwardly, reducing the deformity to the condition of talipes equinus."[2]

If the infant be robust, four or six weeks after birth is not too early for the division of the tendons in talipes. When the operation is performed at this early period, the distortion is quickly and easily removed, and the foot becomes well developed: but when it is delayed until the child can walk, much longer time is required for the restoration of the foot, in consequence of the increased rigidity of the affected parts.

The difficulty of keeping the shoe in place for the purpose of extension, which is cited by some as a reason for postponing the operation, is a fable which only demands allusion for the sake of contradiction.

Neither is pressure to be feared as a consequence of applying the shoe at this early period. I have never seen an accident, however slight, occur from this cause.

The operation when performed at this time, and the after-treatment, are so simple, that I hold it to be unjustifiable in the surgeon to seek delay, except on other grounds than age alone. The health of the child may require delay; but I know no other reason for postponement, if it be not the convenience of all parties concerned.

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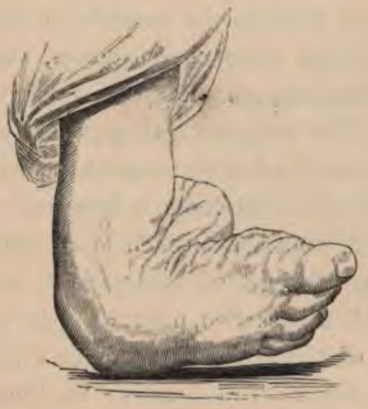
[1] 'Practical Observations on the Treatment of Club-Foot,' p. 6, 1853.

[2] Op. cit., p. 284.

In adults, age alone is scarcely a disqualification for division of tendons, and the restoration of the limb to its normal position: other circumstances must also be considered, namely, the rigidity of structures and the mobility of the limb, as well as the health of the patient. After the age of forty, the time occupied by the treatment is necessarily long; but if extension be practicable, patient perseverance, aided by well-adjusted instruments, will at length restore shape to the most distorted limb. The following drawings (figs. 29 and 30) were made, before and after the removal of distortion, from the foot of a young man, aged 19, lately under my care.

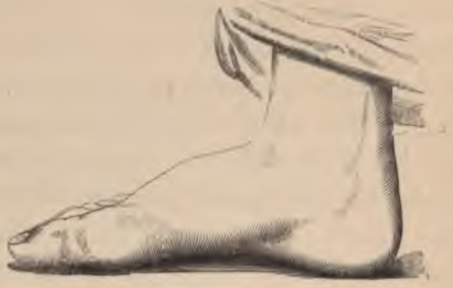
Fig. 29.



In talipes varus it is convenient to divide the tendons in the following order: tibialis posticus and flexor longus digitorum; secondly, tibialis anticus; and lastly, tendo Achillis.

To divide the tendons of the tibialis posticus, and flexor longus digitorum muscles, the patient should lie on his side,

Fig. 30.



the inner side of the leg being turned uppermost, or towards the operator. The operator, standing or seated behind his patient, will endeavour to feel the edge of the tendon; or, if that be impracticable, the edge of the tibia. In fat children, it may even not be possible to define the edge of the bone. Under these circumstances, the knife may be inserted midway between the anterior and posterior aspects of the leg. The assistant, being placed opposite to the operator, steadies the foot and leg, at the same time slightly bending the knee. The knife is then to be inserted at the point indicated, from half an inch to an inch and a quarter, according to the age of the patient, above the inner malleolus, and to be carried, perpendicular to the surface, on to the fascia of the leg, which is to be divided close to the edge of the tibia. The opening in the fascia may be increased without enlarging that in the skin by using a lever motion of the knife. The sharp-pointed knife is then to be withdrawn, and to be replaced by the round knife, which is to be passed down by the side of the bone in the opening made in the fascia, to the distance of nearly half an inch. If the knife be held perpendicularly, and allowed to drop down by the side of the bone, it will be felt with a slight lateral movement, to be between the tendon and the bone. The knife may then be very slightly withdrawn, and its edge turned towards the tendon. At the same time, the assistant will rotate the anterior portion of the foot downwards; and the handle of the knife being slightly inclined, the tendons will be divided.

The snap and yielding at the moment of division, will be felt and heard by the operator, and his assistant. When, however, the tendons have been previously divided, probably no audible snap will occur, and the yielding will be less distinctly felt.

Occasionally, when the tibialis posticus tendon is very tense, it lies on the edge of the tibia, and may be divided in that position with the sharp-pointed knife. Some operators use the sharp-pointed knife alone, for division of the posterior tibial tendon in its ordinary position, by the side of the bone. This practice is, however, attended with more danger to the artery than the mode of division above recommended. It is, however, perhaps easier of execution than with the round knife, and undoubtedly quicker.

Or, in slight distortion, the tibialis posticus tendon may be divided beneath the inner malleolus as it passes to its insertion in the scaphoid bone. In severe distortion, however, the tendon cannot be divided in this situation, the extremity of the inner malleolus being in contact with the scaphoid bone.

So soon as the tendons have been divided, a dossil of lint is to be laid on the wound, and there held by the finger of the assistant until the tibialis anticus tendon has been divided.

For division of the tibialis anticus tendon, the patient is to be placed on his back, and the tendon is to be sought as it passes over the joint nearer to the malleolus than in the normal position of the foot. It may usually be felt without difficulty.

A sharp-pointed knife is to be inserted close to the tendon, and between it and the artery, and being passed well beneath the tendon, the assistant will rotate the foot downwards and outwards, and the operator raising at the same time the edge of the knife, the tendon will snap asunder.

Lint having been applied to the wound, and a bandage to the foot and leg, the limb is to be bound to a small flexible splint bent to the inner curve of the foot.

After-treatment.—In the infant this is for the most part very simple. On the third or fourth day, the bandage and lint are to be removed, when the punctures will have healed. The foot and leg are again to be bandaged and secured to a pliable splint, placed on the outer side of the leg and foot; and by means of this splint and bandage, moderate traction will be made on the foot, until it is brought not only into the median line, but beyond it. Care must be taken, however, not to abduct the foot beyond a natural degree of eversion, lest valgus be substituted for varus. This portion of the treatment will occupy a period of three weeks, and when completed, the foot will be reduced to the condition of equinus; which is then to be treated as directed; p. 108.

But after the first few months of infantile life, the after-treatment becomes more complicated; and in the adult will demand the greatest patience of all concerned, and the nicest care of the surgeon.

From what has been said of the anatomy of varus, it will be understood that it is not possible to overcome a severe form of varus in the adult by abduction and flexion of the foot alone. But two motions are alone provided for in Scarpa's shoe; namely, abduction and flexion; and, consequently, additions have been made to the shoe, termed clamps, by means of which expansion of the arches of the foot is effected. Without criticising these too closely, it may be stated that they have become unnecessary since a modification of Scarpa's shoe has been in use.

A modification of Scarpa's shoe has been for some time used in Hamburg, by Langard, which is extremely ingenious, and which comprises, in a very simple mode of action, all the movements of the foot. The principal defect of this instrument consists in its various motions being effected by means of bands; so that extension cannot be made equably: moreover, its action is too much in the hands of the patient himself, who can remit extension, and consequently retard the cure.

Taking this instrument as my model, and considering the motions to be effected, I availed myself of the ingenuity of Mr. Bigg to construct an instrument, by means of which the scaphoid bone, together with the anterior portion of the foot, is first rotated inwards and downwards; secondly, the foot is extended and abducted; thirdly, flexion is effected; and fourthly, the heel and the entire foot are together acted on. Thus, every desired motion is accomplished, and the worst and most obstinate forms of varus are readily brought under the surgeon's power.

A superficial examination of the bones of the foot in varus is sufficient to render it obvious that the motions of Scarpa's shoe are wholly inadequate to restore the positions of the bones, and the normal shape of the foot.

First, rotation of the scaphoid bone has to be overcome; for this, then, there is a special movement in the instrument above alluded to. And restoration of the scaphoid bone to its position relative to the astragalus, simplifies and hastens the subsequent mechanical treatment.

This instrument is seldom required during the first year of life; yet, in severe distortion the treatment is rendered more simple, and the time necessary for the reduction of distortion is shortened by its employment.

After rotation of the scaphoid bone has been overcome, extension and abduction of the foot are to be made, the arches of the foot are to be expanded, the metatarsal bones to be rolled out from the sole, and thus the normal plant of the foot is to be restored. This is frequently a long process, and difficult of execution. It may occupy from four months to two years, and it requires much care to prevent irritation of the skin. A well-fitting instrument is a *sine quâ non* towards the removal of adult varus. The unfolding of the metatarsal bones is the point of greatest difficulty in the treatment of varus. This, however, may be accomplished with or without the aid of a pad, for greater pressure in the sole of the foot, according to the amount of rigidity of the various structures. In consequence of the shortening of the ligamentous structures on the inner side, and in the sole of the foot, extension requires to be made very slowly. Haste is utterly inadmissible, and, indeed, only retards the ultimate reduction; for pain is excited, and probably ulceration of the skin, through unequal pressure, and even inflammation of the deep structures.

In obstinate adult varus, division of the ligaments on the inner side of the foot may be safely and advantageously practised: especially the deltoid ligament, may, in old, rigid cases, with advantage be incised; and, I conceive, that the same may be said of the long plantar ligament.

In infants, removal of distortion is so complete that it is sometimes impossible to assert with precision which foot has been operated on, without searching for the minute cicatrices of the punctures. And not only is the shape of the foot restored, but perfect freedom of use is also gained. The result depends in some measure on the degree of irritability of the child, and on the care bestowed by its mother or nurse, as the case may be: but chiefly, as need scarcely be said, on the proper division of the tendons of the affected muscles, and on the subsequent adaptation and application of mechanical means.

In adult varus the free use of the articulations is seldom so perfectly gained as during infancy; partly, in consequence of changes in the bony surfaces occasioned by pressure, and also, in consequence of the too early discontinuance of measures which would at least have ensured freer motion than that with which adults usually remain content.

After the tendo Achillis has been divided, and complete flexion of the foot has been obtained, passive motion of flexion and extension of the foot will prepare the articulations for use in walking. A similar support as that mentioned when on the subject of equinus is to be worn, to prevent the recurrence of distortion.

A different course to that above recommended is adopted by Velpeau. First, he divides the tendo Achillis, and afterwards any tendons which appear to be tense and prominent, and which seem to interfere with the restoration of the foot. Then, with a powerful instrument for the purpose, he reduces the foot at once to its normal position. And, notwithstanding the extensive laceration due to extraordinary violence, the results of his treatment are far more favorable than could have been anticipated.

In division of the tibial tendons either of the arteries may be divided; it is an accident, however, of rare occurrence, and happily not of very serious importance. When the posterior tibial artery is divided, the foot is immediately blanched, and the operator is made aware of his awkwardness by the arterial stream. Pressure alone is sufficient to prevent any after consequences. The artery is also liable to be punctured by the sharp-pointed knife, both in division of the fascia, when the knife is inserted too hastily and too far, and in section of the tendon, when the operation is performed with one knife. False aneurism will then result, without the artery be at once completely divided. This course should always be adopted, and graduated pressure be made on the wound, when unfortunately the artery is wounded.

TALIPES VALGUS.—The treatment of valgus in the infant is simple; but in the adult it is often extremely tedious.

In infantile valgus the peronei tendons are to be divided; or, together with them, those of extensor longus digitorum and the tendo Achillis, and also those of tibialis anticus, and extensor proprius pollicis, when they are retracted.

In valgus, as in varus, the distortion should first be reduced to the condition of equinus, and then the tendo Achillis should be divided.

The treatment of congenital and non-congenital valgus is essentially different; the former depending solely on muscular traction; but the latter, for the most part, on debility, and on relaxation of the plantar ligaments.

After long continuance, however, of congenital distortion, muscular traction and distortion occasion loss of elasticity in the plantar ligaments, and at length these become abnormally extended. In infancy, the ligaments are little affected in valgus, except in the most severe forms of distortion; so that on division of the tendons the foot is easily restored to its normal position.

To divide the peronei tendons, the leg should be placed with the outer side uppermost, and a sharp-pointed knife be passed beneath the prominent tendons, and between them and the fibula. On depressing the handle of the knife, the assistant at the same time rotating the foot downwards and inwards, the tendons will be felt to yield to the knife, and will probably be heard to snap. The patient, then lying on his back, with the dorsum of the foot presenting upwards, the extensor longus digitorum and peroneus tertius tendons are to be divided as they pass over the tibio-tarsal joint. A sharp-pointed knife is to be passed on the inner side of the prominent tendons beneath them; the edge of the knife will then be raised towards the tendons, at the same time that the anterior portion of the foot is slightly depressed and inverted. And in a similar manner the knife is to be passed on the inner side of the artery, beneath the tendons of tibialis anticus and extensor proprius pollicis. After these have been divided, the foot is to be bandaged, and bound to a splint, to prevent motion.

After-treatment.—When three or four days have elapsed, and the punctures have healed, extension may be commenced, in a direction downwards and inwards, supporting, at the same time, the inner arch of the foot. A similar apparatus to Scarpa's shoe, the spring being on the inner side of the foot, may be used to reduce the distortion. Neither in this nor in any other form of infantile talipes is violence in reduction required, but attention only to the right direction of the extending force, to overcome retraction and to restore the position of the foot.

When distortion has existed during many years, the ligaments become more unyielding, and the bones consequently more difficult of replacement; longer time is therefore necessary for the removal of distortion.

In congenital valgus the tendo Achillis, as a rule, requires to be divided, before the shape of the foot can be perfectly restored; but, in non-congenital valgus, on the contrary, division of the tendon is usually not necessary to the replacement of the foot; retraction of the muscles of the calf occurring after extension of the deltoid ligament and sinking of the arch of the foot has taken place, and frequently only after flattening and eversion of the foot are complete.

In youth, the deltoid ligament first yields; the foot then becomes slightly everted; the weight of the body is unequally borne on the arch of the foot, the inner portion of which sinks, whilst the outer border is raised, and the peronei become tense.

In làter life, the deltoid ligament is less affected, and the ligaments in the sole of the foot first become elongated.

The treatment requires to be long continued in this variety of valgus, and it frequently becomes very tedious, in consequence of the age at which distortion occurs. There is difficulty in continuing efficient support to the arch of the foot. And even after the arch has been perfectly restored, support is required during many months, and walking is still painful; and so much so, that only a limited amount of exercise can be taken.

In non-congenital valgus the peronei tendons should first be divided; and, after the arch of the foot has been restored, the tendo Achillis also, if it be tense and does not permit of flexion of the foot, should be divided. But, in commencing distortion, support to the arch of the foot and the ankle is alone required; the slight distortion which then exists may be removed without the division of tendons. A stiffened boot to support the ankle, and a vulcanized india-rubber pad, to support the plantar arch, will probably be sufficient to prevent the increase of distortion, and to restore the arch of the foot.

After long-standing distortion, and when it has been necessary to divide the tendons, a spring pad, resting beneath the arch and upon the bones, and attached to a splint on the inner side of the leg, may be worn until the restoration of the tarsal bones and the arch of the foot is complete. This should be worn until the arch of the foot is fully raised.

But it need scarcely be said, that local treatment alone is insufficient permanently to overcome distortion: the shape of the foot may be restored, and, with the aid of support to the arch, exercise may be taken; but on discontinuing support, distortion will probably recur, without a healthy condition of structures in the sole of the foot, and indeed without amelioration of the general health, and increased tone, can be obtained. To this end, other than mere local treatment is necessary.

TALIPES CALCANEUS.—Congenital talipes calcaneus is only observed during infancy; the power of the extensor muscles of the foot being but little impaired, they in time overcome the increased action of the flexors. Even before the child begins to walk this is in great measure effected; but, when the foot is brought into action in walking, retraction of the flexor muscles is entirely and rapidly overcome. Slight retraction, however, may still remain at two years of age, or even later; but as the foot resumes its normal position the power of the gastrocnemius muscle rapidly increases.

The treatment of this distortion consists, consequently, in assisting nature to overcome the increased action of the flexor muscles; or, in the most severe forms of distortion, to divide the tendons of tibialis anticus, extensor longus digitorum, extensor proprius pollicis, and peroneus tertius muscles.

The tendons are to be divided, the patient lying on his back, and the dorsum of the foot presenting upwards. The knife is to be passed beneath the tendons of extensor longus digitorum and peroneus tertius muscles, and on the outer side of the anterior tibial artery, care being taken to avoid the artery. The edge of the knife will then be raised towards the tendons, and these divided as the foot is extended. Again, the knife is to be passed on the inner side of the artery, and close to the prominent tendons of M. tibialis anticus and extensor proprius pollicis, which will be divided in a similar manner to those last mentioned. The foot and leg will then be bandaged to a flexible splint, as in the other forms of distortion, and so retained until the punctures have healed. Extension is then to be made slowly, and continued until the foot is fully extended.

Non-congenital calcaneus is for the most part of paralytic origin: the muscles of the calf of the leg lose their power, and allow the heel to drop. And muscular antagonism being removed, the flexor muscles of the foot retract, as well as those in the sole of the foot, to draw the anterior portion of the foot upwards, and the heel downwards and forwards. The heel in consequence alone rests on the ground, the sole being more or less raised in proportion to the loss of power which has been occasioned, and also, in some measure, in proportion to the time during which distortion has existed.

Division of the flexor tendons may here be necessary, as in congenital calcaneus. The plantar fascia also may require to be divided. The arch of the foot is then to be restored, by depressing the metatarsus and raising the os calcis.

After-treatment.—After tenotomy, as well as without section of the tendons, a straight splint, to which the foot and leg are to be bandaged, may be used for making extension; but Scarpa's shoe, or rather a modification of Scarpa's shoe with a dorsal piece attached, is a more convenient instrument for graduating extension, and also for the use of the patient. Nothing can be more simple than the treatment of this form of talipes.

After distortion has been entirely removed it seldom recurs; and the more the foot is used, and the power of the gastrocnemius is increased, the less is recurrence of distortion to be feared. In very severe cases distortion may recur, as every other form of congenital distortion may relapse after removal: I have never known calcaneus to recur, however, in the slighter forms, and those most frequently met with. But, that all chance of its recurrence may be avoided, it is sufficient to wear the extending apparatus during the night,—to keep up a moderate degree of extension of the foot, for some months after the operation.

After contraction in the sole of the foot and on the anterior surface of the leg in non-congenital calcaneus has been overcome, and the os calcis has been again raised to its normal position, a spring may be worn, attached beneath the heel in the shoe, and an iron support is to be attached to the shoe, having a free joint corresponding to the ankle-joint.

Or, calcaneus arising from other cause than paralysis will require treatment not dissimilar to that necessary for congenital calcaneus. This difference, however, may be noticed between congenital and non-congenital distortions, that in the former, removal of distortion and restoration of motion, immediately constitute a most useful, not to say a perfect, limb; but in non-congenital distortions freedom of the articulations may probably exist with very slight power of motion. Restoration of function is scarcely less important than restoration of position: a few words will, in conclusion, be devoted to this part of the subject.

Non-congenital distortions, of whatever kind, whether arising from paralysis, spasm, articular inflammation, debility, or other cause, do not, in the commencement of distortion, require tenotomy for their removal, but may be removed by the careful application of mechanical means, together with medical aid.

A large number of cases of distortion, which at present occupy the attention of the surgeon, might, with care, and the timely use of mechanical support, be wholly prevented; such are the majority of paralytic distortions. But when distortion has occurred, it may frequently be removed by mechanical aid alone, and power at the same time be restored to the weakened muscles. Again, in spasmodic affections, tenotomy is both unnecessary and pernicious, whilst irritation — the cause of distortion still exists. And distortions arising from debility, may, before structural changes have been induced, be removed by support to the affected part, together with attention to the general state of health.

Articular inflammation is a frequent source of distortion. All the muscles and their tendons around a joint may become rigid, to lock the joint at a right angle; or a single set of muscles may exceed the others in rigidity, and in consequence determine the specific distortion. To endeavour to recover motion, or to remove distortion, whilst the joint is still painful, would probably reproduce inflammation; but inflammation and abnormal sensibility having subsided, the rigid muscles may, without surgical interference, or by means of gradual flexion and extension, be restored to their normal action; for they became rigid to prevent motion and pain, and as the joint is restored, they likewise are restored to their normal condition. But when articular inflammation is the cause of muscular retraction, force should never be used to overcome retraction: it is preferable to divide, when necessary, every tendon around a joint which interferes with motion, than to risk re-exciting inflammation.

When suppuration has taken place, and the interior of the joint has become extensively affected, dislocation may be prevented and distortion be overcome by gentle extension. Extension will also be well borne at this period, and frequently abscess will heal under its influence. This applies, however, rather to the hip than to the ankle-joint.

Adhesions occasionally form within the ankle-joint which have to be broken through. When such is the case, chloroform is first to be administered, and the adhesions are to be destroyed after the tendons have been divided.

The foot is then to be reduced to its normal position, and passive movements are subsequently to be employed, until the required motion, or such as is possible, is attained.

Traumatic inflammation may involve the integuments only, or the deeper structures also. When the integuments only are affected, and before structural shortening of the muscles involved in the distortion has taken place, mechanical extension will suffice to restore the position of the limb; but when structural shortening has taken place, or when the muscles are primarily implicated in the lesion, division of their tendons will probably be necessary before replacement of the limb can be effected.

But, although tenotomy may be, and often is, unnecessarily applied, distortion should never be allowed to increase whilst remedial measures are being applied. Mechanical support must be efficiently used to remove distortion, rather than to suffer it to increase.

Much obloquy has been cast on orthopædy in consequence of the abuse of tenotomy. The senseless division of tendons on every possible occasion, and without reference to the cause of distortion, has occasioned infinite injury to the cause of orthopædy; congenital and non-congenital affections being similarly treated by those who, through ignorance of the pathological condition of parts (directly or indirectly involved) are unable to form an accurate diagnosis —to distinguish between the various forms of non-congenital distortions, and to decide between cases fitted and unfitted for the section of tendons.

When the flexor muscles are paralysed, supports with a stop-joint at the ankle are necessary to prevent recontraction of the extensors. And after the shape of the limb is perfectly restored passive exercise may be employed, together with friction, and the use of stimulating applications in the course of the paralysed muscles; baths, and galvanism may also be used with advantage.

The question of paralysis in its early stages has not to be considered in these pages, but loss of power comes under consideration only after distortion has been occasioned. Myogenic paralysis is frequently benefited by stimulating applications. Cutaneous rubefacients are employed with marked benefit; small flying blisters may be used, or equal parts of oil and turpentine, or, as in the accompanying formula:

℞ Sp. Camphoræ, ℥vj;
Ol. Terebinthinæ, ℥j;
Sp. Ammoniæ, ℥ij.
M. Fiat linimentum.

The treatment of spinal paralysis after long continuance of distortion is rarely satisfactory. However, should muscular power be only in part restored, and facility of movement be gained, the latter of which is in great measure accomplished by the restoration of the shape of the limb, the comfort of the patient will have been greatly increased, and pain in walking exchanged for comparative ease and immediate increase of power. And not only so, but troublesome ulcerations, which are of frequent occurrence in paralytic distortions, are in great measure, if not wholly, prevented by the means here inculcated to restore the position and use of the limb.

Friction and counter-irritation along the course of the spine are occasionally beneficial in spinal paralysis, or in some forms of spinal paralysis; but they often disappoint expectation. And the use of mercury, whether by inunction or otherwise, is rarely indicated, and more rarely beneficial.

I am strongly inclined to the employment of galvanism in weak currents, for two or three minutes every day, or every second or third day, according to the age and strength of the individual. Also, advantage is to be derived from the electro-galvanic puncture. The needles should be passed into the muscles, and the current be proportionate to the effect to be produced, and to the ability to bear it.

Sulphate of strychnine in minute doses—one hundredth to one fiftieth of a grain—is recommended, amongst others, by Heine, who asserts that under its influence the heat of the paralysed part is restored and cutaneous moisture promoted. Any experience that I have had of the use of this drug tends to confirm me in the opinion that its immediate effects are valuable, and in some respects, at least, certain: I am inclined, however, to question the remote advantages to be derived from its use. Sulphate of zinc is perhaps one of the safest and most efficient of the class of nervine tonics. It may be given to children three times a day in doses of one grain, which may be gradually increased to four or five grains. These doses generally create slight nausea, but they will be borne even by delicate children.

In the spasmodic affections of children, the state of the gums should be inquired into: when they are swollen and painful they should be incised: and even should the swelling be inconsiderable, it is safer to divide the capsule of the tooth than to leave the child in pain. Worms in the alimentary canal may be removed by purgative medicines or by injections. Copious injections of warm water into the lower bowel is one of the most simple and effectual modes of removing these sources of irritation. Equal parts of Ol. Terebinthinæ and Ol. Ricini, are also given with advantage in doses of half an ounce, followed by the infusion of senna. And when children are subject to the accumulation of these entozoa, the sulphate of quinine in small doses, or exhibited in larger quantities in enemata, acts admirably as an anthelmintic remedy, and as a tonic.

In congenital distortions friction and movements are alone necessary, after complete restoration to the normal position, to ensure the free use of the articulations.

In infants, passive movements of the foot are unnecessary to restore the use of the joints, except in the most severe forms of distortion. They are useful however in preventing re-contraction of the muscles, and consequently should be practised in every form of congenital affection.

In adult congenital talipes, movements imparted by the hand, tend to the elongation of ligaments, and to the more rapid removal of distortion; they may, consequently, be advantageously used from time to time during the progress of reduction. And when the shape of the foot is fully attained, flexion and extension may be made, to overcome rigidity, and to gain the free use of the limb. At this time, friction and bathing are most useful in expediting the cure.

In a large number of non-congenital cases of distortion, especially of varus and valgus, as well as adult congenital varus, frictions with camphorated oil are useful in restoring the natural heat and suppleness of the limb. The mineral tonics also, especially iron, either in the form of the ammonio-tartrate, the ammonio-citrate, or the tincture of the sesquichloride, are useful when debility has induced distortion, and is still present. And when the bowels are habitually torpid, as it frequently happens, both when there is anæmia and also when there is a spasmodic condition combined with anæmia, Tinct. Ferri Comp. with Decoct. Aloes Comp. may be advantageously employed.

One or many of these adjuvants may be necessary to restore power after the removal of non-congenital distortion; but the functions of the limb are for the most part restored, after congenital distortion has been removed, without further aid than passive motion. In both instances a most useful limb may result. In many forms of non-congenital distortion, however, complete return of power is doubtful, and in a large majority improbable; but in every congenital affection return of power is certain on restoration of the limb to a normal position; and during infancy, in youth, and until middle life is attained, the perfect and free use of the limb may be gained.

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